

**Carbon Sink Reforestation Projects: a  
Community Perspective from KwaZulu–Natal,  
South Africa**

**by  
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## **Abstract**

Climate change has exacerbated environmental degradation processes, causing an imbalance in the natural concentrations in atmospheric greenhouse gases. This has resulted in a myriad of socio-economic effects which have focused global attention on methodologies to reduce these effects, such as carbon sequestration. To achieve long term sustainability and success, community involvement in the technical and social aspects of carbon sequestration projects is necessary and must be acknowledged. One such mitigation methodology which incorporates the ideals of community proactive participation is carbon sink reforestation projects. This study is based on a community perspective of a carbon sink reforestation project, carried out in KwaZulu-Natal, South Africa. The study provides a holistic perspective of the concept of carbon sequestration drawing together technical aspects of carbon sequestration reforestation projects and the inclusion of the role of communities.

The methodology comprised of questionnaires with industry experts and a local community, following a thematic data analysis. The current perception from industry is that the South African government lacks significant technology, capacity and finance to effectively manage national forest carbon sequestration regimes. Project participants expressed the view that these types of projects provided a sense of belonging and hope and articulated their gratitude for the environmental knowledge they gained from the project experience. Technical and social aspects of such projects such as carbon calculations and participatory rural appraisal techniques enhance a country's ability for successful implementation of such projects. Findings reveal a need for technology, capacity building and finance; and the effects participation in these projects has on individuals. This is followed by recommendations and a 'How To Guide' developed by the researcher. This guide intends to enhance the collaboration of the technical aspects and involvement of communities throughout the project implementation process. Carbon regimes in this century will continue to grow in size and complexity. Stakeholder participation will be a strong factor in the success or failure of carbon sequestration reforestation projects.

## Declaration

I Sarisha Ramanand declare that:-

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## Acronyms

ABG	Above Ground Biomass
AWG-ADP	Ad Hoc Working Group on the Durban Platform for Enhanced Action
AFOLU	Agriculture, Forestry and Other Land uses
AR4/ FAR	Fourth Assessment Report
BAU	Business as usual
BGB	Below ground biomass
CCBS	Climate, community and Biodiversity Standards
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CDM-AR	Clean Development Mechanism Afforestation/ Reforestation
CDM AR-AMS0001	Simplified baseline and monitoring methodologies for small-scale A/R CDM project activities
CER	Certified Emission Reduction
CNS	Carbon, Nitrogen and Sulphur
CO <sub>2</sub>	Carbon dioxide
COP	Conference of Parties
DBH	Diameter above breast height
DME	Distance Measuring Equipment
DOE	Department of Energy
FCCC	Framework Convention on Climate Change
FIFA	Fédération Internationale de Football Association
GDB	Geo-DataBase
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
Gt C	Gigaton of carbon
IET	International Emissions Trading
IPCC	Intergovernmental Panel on Climate Change
ITFL	Indigenous Trees For Life
JI	Joint Implementation
JSE	Johannesburg Stock Exchange

LULUCF	Landuse, Landuse change and Forestry
MDG	Millennium Development Goals
mm	Millimeters
MRV	Monitoring, Reporting and Verification
MtC	Megaton of carbon
NCAT	National Carbon Accounting Toolbox
NCCRP	National Climate Change Response Policy
NGO	Non-Governmental Organisation
PFM	Participatory Forest Management
PIN	Project Identification Note
PDD	Project Design Document
Ppm	parts per million
REDD+	Reducing Emissions from Deforestation and Degradation
RMB	Rand Merchant Bank
ROSE	REDD Opportunities Scoping Exercise
SA	South Africa
SBSTA	Subsidiary Body for Scientific and Technological Advice
SOP	Standard Operating Procedure
TAR	Third Assessment Report
tC	Tons of carbon
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation.
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
VCM	Voluntary Carbon Market
VCS	Voluntary Carbon Standard
WCT	Wildlands Conservation Trust

# CHAPTER ONE

## Introduction

### 1.1 Introduction

Interactions between mankind and the environment are complex and the resources used to fulfill everyday requirements are vulnerable and subject to pressures. This has resulted in the global phenomenon now known as climate change. Global climatic change of our atmosphere and its associated weather patterns are no longer forces that we as society can deny. Global shifts in air pressure, ocean currents and environmental conditions are all natural associations of climate change. However anthropogenic climate changes stems from multiple causes such as, the increase in the human population together with industrialization mostly through unsustainable standards of living. An increase in the global population is directly proportional to an increased demand for goods and services hence, greater pressure applied on our natural resources. Two of the main drivers of climate change are fossil fuel usage and deforestation, both having a negative effect on the carbon content in the atmosphere. The effects of the drivers of climate change reduce the ability of the Earth's natural sinks to sequester carbon, through associated negative effects of land use change (Ometto *et al* 2005).

Ongoing destruction of forest and natural vegetation results in higher concentrations of CO<sub>2</sub> in the atmosphere. As stated by Ometto *et al* (2005) deforestation affects the atmosphere in several ways, namely; a change in the energy and water balance when forest is replaced by pasture has the potential to alter the atmospheric water content and precipitation patterns. The UN Millennium Summit hosted by South Africa (SA) in September 2000 detailed the seventh millennium development goal (MDG) as “*Ensure Environmental Sustainability*” (Millennium Development Goals Midterm country report, 2007). One of the related targets to this goal was to reduce or contain greenhouse gas (GHG) emissions. South Africa has developed a National Climate Change Response Policy (NCCRP) ensuring a fair contribution to stabilizing greenhouse gases (NCCRP, 2011:5). One of the mechanisms introduced by the United Nations Framework Convention on Climate Change (UNFCCC) was the Clean Development Mechanism (CDM) which attempts to reduce GHG emissions through

specific project implementation standards (CDM, 2011). However, apart from the globally derived CDM, there are currently no known national or local guidelines for the development of reforestation projects that render the benefits of reduced carbon emissions in South Africa.

Carbon sequestration can be defined as the net removal of atmospheric carbon dioxide into carbon pools that have a lengthy lifespan such as oceans, forests, soil, wetlands and grasslands (National Energy Technology Laboratory, 2010). A carbon sink is a reservoir that absorbs or takes up carbon from another part of the carbon cycle. Carbon sequestration reforestation projects involve the replanting of deforested or degraded sections of a particular forest, which is achieved through a collaborative effort, in most cases, between experts and forest dependent communities. These types of projects are of interest to experts and policy makers as a mechanism to reduce carbon emissions, whilst conserving biodiversity and attempting to include local communities in the process. This is argued by Hallowes (2002) as he points out that the past century's experience of industrialization, urbanization, and rural dispossession did enormous damage to society's ecological inheritance in South Africa. Despite scientific algorithms and related methodologies developed by scientists to quantify carbon dioxide emissions that are sequestered through carbon sink initiatives, efforts made to implement such projects would prove more beneficial if the 'social' elements of such projects were paid more attention such as those elements that render poverty alleviation benefits (Whitmarsh *et al* 2011).

History demonstrates that an attempt to conserve the world's resources involves treating the symptoms and not investigating and treating the root cause to issues surrounding climate change. This is the perspective of many world organisations regarding the idea of 'reduced carbon emissions'. However, on the contrary many organisations are beginning to focus on improving the integrity of climate change mitigation techniques such as carbon sequestration. KPMG (2011: par 15) provides an example of this type of thinking, as it states that as public awareness of climate change intensifies, company responses to the problem have become a significant reputational and strategic issue. This form of climate change mitigation initiative is a recent development in southern Africa. Forest degradation caused by population pressure and overexploitation is a problem in some areas of South Africa and recent

years have seen a reprioritization of Community Forestry (SADC, 2011). The South African 1996 “White Paper on Sustainable Forest Development” emphasises participation of stakeholders in policy development and in management decision-making (Department of Water Affairs, 2012).

Often the efforts to reduce the negative effects of climate change are not communicated effectively to affected stakeholders’ (Whitmarsh *et al* 2011). This defeats the purpose of creating an atmosphere of understanding when attempting to conserve the world’s resources or treating the causes and adds greater complexity to the implementation of carbon sequestration projects. Greater effort needs to be placed on appropriate education and informing those that will be directly involved in these initiatives. Despite extensive and ongoing discussions, there are certain elements of the global discussion that are not fully explored, such as stakeholder participation, the capability of one’s understanding and engagement with climate change and the long term effects on local and indigenous people. As a result, this global discussion forum has failed to produce holistic methodologies in terms of reforestation carbon sequestration projects that include guidelines on stakeholder participation (Whitmarsh *et al* 2011).

Political parties have agreed that governments must intervene to protect the human population, and biodiversity from potentially catastrophic over-exploitation of natural resources and the phenomenon of climate change. The approach taken to convene issues of carbon sequestration, reforestation and Reducing Emissions from Deforestation and Degradation (REDD+) are under the UNFCCC. UN-REDD (2009) describes REDD+ as an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. However, as pointed out by Lang (2011), the idea of making payments to discourage deforestation and forest degradation was discussed in the negotiations leading to the Kyoto Protocol, but was rejected due to four fundamental problems: leakage, additionality, permanence and measurement. These are issues that are still to be discussed in ongoing UNFCCC discussions at COP 17 in Durban, South Africa.

“...most professional works tend to focus on specific topics rather than provide a basic and comprehensive picture of carbon sequestration” (Kobayashi, 2004:153). Taking this into account, South Africa’s first ever community carbon sink reforestation project, the Mkuze River Floodplain Carbon Sink project was chosen as a case study for this research. It is hoped that detailing a possible procedure for the development of carbon sink reforestation projects in South Africa using this case study as a focus, will lead to better direction for project developers and implementing agents or organizations. By investigating the current understanding and perceptions of climate change and carbon sequestration by ordinary members of society and project participants, an improved understanding and appreciation for the severity of the current climate crisis will lead to the ultimate success of such initiatives and project programmes, hence contributing to the reduction of carbon emissions in South Africa.

### **1.2 Aim and Objectives**

**Aim:** To investigate the Operational Potential of Carbon Sink Reforestation Projects through the perceptions of affected communities and stakeholders involved in carbon sink reforestation initiatives, a case study analysis in KwaZulu-Natal, South Africa.

#### **Objective(s):**

- 1) To document and interrogate global and local policies and existing methodologies related to carbon sequestration projects.
- 2) To analyse the knowledge and perceptions of communities regarding climate change and carbon trading.
- 3) To investigate the operational potential of carbon sink projects through a critical realist approach
- 4) To formulate an applied guideline that outlines key procedures for carbon sink project implementation, providing guidance for carbon sink project developers or implementing agents.

### **1.3 Structure of the Thesis**

Chapter One which introduces the research, the underlying principles of the research, aim and objectives. Chapter Two provides a detailed literature review, developing a theoretical foundation to the research with current international and national information. Chapter Three includes a description of the study site together with community demographics.

Chapter Four provides a detailed account of methods, outlining the research design and data analysis procedures. Chapter Five describes the results, including graphical, numerical and explanatory representation of results; whilst Chapter Six details the 'How To Guide', a step-by-step guideline, outlining the broad procedure of implementing a carbon sink reforestation project. The "How To Guide" forms part of the study as a practical and applied guide that aims to (1) create a platform for further research in this field and (2) give a detailed account of what elements are required in implementing these projects. Chapter Seven provides a discussion, recommendations and conclusions, whilst Chapter Eight presents the research conclusions.

## CHAPTER TWO

### Literature Review

#### 2.1 Introduction

Generations of human beings have experienced the negative effects of exploitation of the natural environment and in particular the atmosphere. Scientists and environmentalists speculate that within the next 50 years the climate of the earth may be warmer than at any time in the past thousand years. “There is, however, a widely believed hypothesis that the 3 Gigaton Carbon (Gt C) per year rise in atmospheric carbon dioxide is the result of the 5.5 Gt C per year release of carbon dioxide from human activities.” (Robinson, 1998:1). Ample evidence suggests that there is a global rise in atmospheric carbon dioxide content, causing a marked increase in temperatures. According to the Third Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), “the world average temperature is on an increasing trend with an estimated increase of 2.5 to 10.4 degrees Fahrenheit over the period 1990 to 2100” (Kobayashi, 2004:153). This is supported by the IPCC Fourth Assessment Report (FAR/AR4) which states that observed temperatures indicates a greater warming trend since the 1960s; while decadal warming trends have been observed for South Africa in the order of magnitude 0.1 to 0.3 °C (Boko *et al* 2007:436).

Southern Africa is likely to experience a drier climate in some areas whilst the rainy seasons are predicted to increase in volume and intensity. In a broad sense, a changing climate has numerous mitigation and adaptation consequences for Africa. The Climate Change and Agriculture in Africa group (2002: par 7) make an important point stating that Africa's vulnerability to climate change and its inability to adapt to these changes may be devastating to the agricultural sector, the main source of livelihood to the majority of the population. South Africa is readily engaging in multilateral climate change decision making processes and negotiations despite being a developing economy. While this is a proactive step, the country and its people are faced with numerous challenges such as poverty, water scarcity, and sanitation problems. Climate change is more than likely to increase the effects of these

problems. The negative impacts that result from climate change justify the need for carbon sequestration as a strategy for climate change mitigation and adaptation. The sequestration activity to be dealt with in this research is carbon sequestration through reforestation activities.

It is hypothesized that the actions of human beings are the primary culprits of these untimely adjustments to the changes in atmospheric content. During the course of history the dependence for an accessible and readily available source of energy has caused a major shift to the use of coal. As a result, industrial activity has grown in an unprecedented manner since the Industrial Revolution with the world combusting 400 years worth of this accumulated, compressed biological matter every year (Lohmann, 2006), which has ultimately led to the increased production of carbon dioxide. As mentioned by the DOE (2006: 81), “In the *IEO2006* reference case, world carbon dioxide emissions increase from 25 028 million metric tons in 2003 to 33 663 million metric tons in 2015 and is proposed to reach 43 676 million metric tons in 2030”. This supports the view of the effects of the world’s continued reliance on fossil fuels – coal, oil, and natural gas – as its primary energy source (O’Driscoll and Vergano, 2007). Human activity adds CO<sub>2</sub> from combustion and deforestation, decreases photosynthesis by deforestation and soil degradation, and increases carbon in sediments by erosion of soils. As a result, almost half the carbon accumulated is released into the atmosphere (Goreau, 1990). This process reaches a point where the atmosphere begins to act as a greenhouse that allows the sun’s short wave radiation in but does not allow the earth’s long wave radiation out.

Lohmann (2006) points out that the land biosphere potential to hold carbon is approximately 2 000 billion tonnes and is temporary due to the natural carbon cycle (Table 2.1). Despite the temporary storage of carbon in this form, decisions regarding the reduction of GHG emissions must be made in the short to medium term. Fearnside (2001) makes it clear that we need to have the courage to admit that we are making moral decisions, and to move forward with confidence in making such decisions. It is important for global society to come to terms with the fact that there is a high price to pay if ignorance and procrastination are not dealt with. Over a decade ago most countries decided that steps needed to be taken to consider what can be done to cope with whatever temperature increases are inevitable. Carbon sequestration in the form

of carbon sinks has been accepted as a viable option for reducing the amount of carbon dioxide in the atmosphere on a global scale (UNFCCC, 2011).

Table 2.1 The Earth's Carbon Pools.

<b>The Earth's carbon Pools (Billion tonnes)</b>	
Atmosphere	720-760
Oceans	38400-40000
Rock	75 000 000
<b>Land Biosphere</b>	
Living biomass	600-1000
Dead Biomass	1200
Fresh water	40910
<b>Fossil Fuels</b>	
Coal	3510
Oil	230
Gas	140
Other	250
<b>Annual transfer of fossil carbon</b>	
to above ground carbon pools	7+

Source: Lohmann (2006:7)

The carbon pool stock (Table 2.1) in various categories of sinks illustrates the approximate storage capacity of each pool, where 7+ indicates the possible increase in the sink potential within the carbon pool. This reveals the possible sequestration or source potential of each sink.

“Global warming alters the probabilities of droughts, floods and other disasters, which, after the temperature increase, can be assumed to remain higher forever” (Fearnside, 2001:178). The concern surrounding the increasing trend of atmospheric carbon dioxide initiated a string of international conferences over the last two decades (section 2.2). These global meetings of the world's nations serve as testament that the earth's ability to cope with anthropogenic climatic changes is not as steadfast as desired.

## **2.2 International policy and legislation applicable to Climate Change mitigation**

“An international effort to stabilize and reduce atmospheric concentration of CO<sub>2</sub> is necessary and carbon sequestration is emerging as a very promising approach” (Kobayashi, 2004:153). One way of reducing the atmospheric carbon emissions is by the process of carbon sequestration. The removal of carbon emissions from the atmosphere takes place naturally in the form of natural reservoirs or sinks that absorb carbon and stores it in trees (forests), vegetation, oceans, wetland systems and soil. Therefore the process of carbon sequestration in the context of this research can be deduced as enhanced sequestration due to activities such as the restoration of forest systems by planting trees.

Climate change mitigation via a reduction in the anthropogenic emissions of carbon dioxide (CO<sub>2</sub>) is the principal requirement for reducing global warming, its impacts, and the degree of adaptation required (Vaughan *et al* 2009). These elements have been taken into consideration by the initiation of numerous climate change conferences and negotiations. “The United Nations Framework Convention on Climate Change was adopted in 1992 at the Rio Earth Summit to address the adverse effects of climate change” (Bettelheim and d'Origny, 2002:1828). The UNFCCC, a global mechanism that is seen as a ‘stabilizing tool’ for the release of GHG emissions through human activity, was adopted by 186 of the world’s nations and came into force mid-March of 1994. The ultimate objective of the Framework Convention on Climate Change (FCCC) is to achieve timely stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Limiting GHG emissions to specific levels is now an internationally recognized objective (Pathak *et al* 2000). Despite it being recognised as an international objective, the larger emitters of the world are still not willing to realise their ‘common but differentiated historical responsibilities’ in particular the United States of America. This begs the question will real reduction of GHG emissions take place for any notable differences in this century?

December 1997 marked the signing of the Kyoto Protocol by more than 150 countries, and binds 38 industrialised countries to reduce their emissions by an average of 5.2% below 1990 levels for the period of 2008 – 2012. Due to the fact that more than 55 countries signed this agreement and more than 55% of developed

countries emissions are covered within the Protocol, this was globally agreed to as international law (David Suzuki Foundation, undated). This was a significant step forward as a definite global commitment to reduce GHG emissions. Post-Kyoto, in October/November 2001, representatives from 172 governments met in Marrakech, Morocco, at the seventh Conference of the Parties (COP 7) to the UNFCCC to complete negotiations on the operational details for commitments on reducing greenhouse gas emissions, set out in the UNFCCC's Kyoto Protocol. "The Accords provided the necessary closure to negotiations on key issues, which now permits countries to initiate the process of ratification of the Kyoto Protocol" (Dessai and Schipper, 2003:149). The UNFCCC COP 17 and CMP 7 were hosted by the government of South Africa in Durban in 2011. This meeting further sought to operationalise the agreements reached during the COP 16 Cancun discussions in 2010, and advance the convention and the Kyoto Protocol (UNFCCC, 2011). Recognizing that COP 17 did not explicitly render any legally binding outcomes, the discussions were successful at securing a second commitment period for the Kyoto Protocol and the launch of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (AWG-ADP). The decisions reached in the document 2/CP.17, chart a way forward for the second commitment period of the Kyoto Protocol.

This brief history illustrates the progression towards the implementation of the Kyoto Protocol and underpins the hope to achieve real GHG emission reductions. As the protocol sets out, there are various ways to reduce GHG emissions and carbon sequestration, as introduced by Canada in 1997, is one such mechanism. "According to the Kyoto Protocol, Annex 1 countries can reduce emissions by limiting fossil fuel consumption or by increasing net carbon sequestration in terrestrial carbon sinks" (IGBP Terrestrial Carbon Working Group, 1998:1393).

According to Chen (2003), the Kyoto Protocol set the quantified reduction commitment for each Annex I Party, however, it is still difficult to ascertain exactly how much GHG should be really reduced due to the uncertain Business As Usual (BAU) emissions for the period 2008–2012. While the uncertainty exists, time eludes the world's leaders on making life altering decisions that require immediate attention and action. The ongoing discussions reflected that 'caps' be set for Annex 1 parties to fulfill their obligations. In this regard a specific cap for each Annex I Party to use the

credit from carbon sequestration resulting from forest activities from both domestic actions and Joint Implementation (JI) projects is stipulated in the decisions of both COP 6 bis and COP 7, both of which are project implementation elements of the CDM (Chen, 2003). While these options were on the table and in ongoing discussion, Swingland (2003:8) points out “the new requirements devoted to 'environmental integrity' have not only raised the costs of compliance of developing country projects but also virtually ignore the fundamental principle of sustainable economic growth and development embodied in the Convention and related international agreements”.

“The regulations for carbon sinks now being formulated at Conferences of the Parties will have a significant impact on their use worldwide” (Bettelheim and d'Origny, 2002:1827–1828). This is further proven by the ‘Australia case’ presented by Hamilton and Vellen (1999) in which it is pointed out that policy measures aimed at protecting forest biodiversity and general ecosystem health require removal of the weeds while sink enhancement policies would see woody weeds grow, multiply and spread with compounding ecological impacts. Clearly defined definitions and policy regulation is required for carbon sequestration projects not only to fulfill their roles as ‘carbon sink’ projects but to holistically maintain ecological integrity. Hamilton and Vellen (1999) note that if woody weed invasion forms part of the definition of vegetation thickening, and is perceived at some stage as a politically desirable CO<sub>2</sub> sink, there will be serious environmental implications.

It is these fundamental issues surrounding definition and scope of the agreements being formed at such negotiations that need to be clearly defined and taken into account. However, Bettelheim and d'Origny (2002) note that the principal achievements of the third COP held in Kyoto in December 1997 were first, to agree that Convention Annex I countries would be bound to quantitative GHG-emissions limitations and reductions commitments specified in Protocol Annex B for the first commitment period (2008-2012) and second, to provide flexible mechanisms (including carbon sequestration and emissions trading) to help achieve these commitments in an economically efficient manner.

As illustrated by the discussion and work carried forward by the COP 3, carbon sequestration as a viable reduction method has gained differing levels of momentum

and popularity amongst parties involved. However, the idea was and still remains, a contentious issue in the global context as it does not fully allow for flexibility during the project phases and lacks coherency with the notion of 'environmental integrity'. Following the signature and the reduction emission targets set by the Kyoto Protocol, three 'flexibility mechanisms' were introduced. These were the International Emissions Trading (IET), JI and the Clean Development Mechanism (CDM). The IET refers to a country with targets which can easily and cheaply be met, may actually achieve an emissions path which is lower than the target level and so would have emissions permits to spare, while the JI and CDM are project based mechanisms. "This means that an investor may fund an emission reduction project in a host country and may receive carbon 'credits' for the emission reductions achieved. JI under Article 6 of the Protocol allows investments to reduce GHG emissions to be made in other Annex I countries. Under the CDM, a project may be hosted by a developing country and the resulting reductions are termed certified emission reductions (CERs)" (Begg, 2002:332). It is important to note that the above mentioned flexibility mechanisms are not without their challenges and criticisms, as it is not a case of 'one size fits all' regarding emission reduction projects.

The discussion items in the UNFCCC forests agenda developed into arguments that reflect on what role Landuse, Landuse Change and Forestry (LULUCF) has to play in this carbon debate and how should this be used as an emissions reduction tool? The LULUCF debate and scope of work includes an extensive set of accounting rules and guidelines that assists the implementing agent or project developer to account for all emissions and removals from the atmosphere in relation to the specific project being implemented. According to Bettelheim and d'Origny (2002), the IPCC noted that issues related to LULUCF carbon sink projects were only addressed in the COP 7. This affects two aspects, the implementation of the Kyoto Protocol and the role of sinks in calculating the basis of assigned amounts and accounting for acquiring reduction credits based on sinks. "Removals by sink must result from 'direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period' (Protocol Article 3(3))" (Bettelheim and d'Origny, 2002:1836 and Kyoto Protocol, 1998:3). The list of concepts interrogated included the 'baseline scenario' which is considered one of the most important issues as it is the defining

foundation upon which calculations of GHG emissions and removals are based. ‘Additionally’; ‘leakage’; and ‘non-permanence’ are other related issues that should be considered during project initiatives.

As mentioned by Bettelheim and d'Origny (2002:1838 – 1839), the COP 6 reached an important agreement on the principles guiding LULUCF activities, stating that “...activities should be based on “sound scientific measures”; and activities must contribute to biodiversity and environmental sustainability...” It appears that the socio-economic aspects of this debate did not adequately feature in these COP decisions as compared to the aforementioned concepts. With REDD+ now a fully fledged agenda item in the UNFCCC negotiations, the complexity of operational and implementation issues are growing. REDD+ is a relatively new mechanism that hopes to achieve emission reductions by keeping the world’s forests intact, and in some cases extend these forests. According to Rahlao *et al* (2012:28), “The current scope of REDD+ mechanism, as agreed in Cancun, 2010, has ensured participation of all countries in the developing world. Within the existing scope of REDD+, South Africa would look at participating through conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks”. It is hoped that in the pursuit to reduce emissions from deforestation and sink enhancement in forests, that the rights of local and indigenous peoples are not infringed upon. This is supported by the NGO Community (A Copenhagen Climate Treaty, 2010:10) where it is stated that, “countries should commit to reducing emissions from deforestation by at least by 75 percent below estimated 1990 emission levels; while respecting the rights of local and indigenous peoples, and protecting biodiversity”.

The inclusion and participation of local communities and indigenous peoples is fundamental to the success of any reforestation activity including any REDD+ project activities. Participation will mean revenue-generating projects that provide funds for development with lower emissions than previously planned development, thereby upholding the sustainable development agenda. It is further recognised that developing countries that do participate will be held to the CDM clause that specifies all projects must be additional. Important to note is that the additionality clauses hold true for all sink projects in the Voluntary Carbon market. This clause must hold true in particular for Annex 1 parties supporting carbon sink reforestation projects, so as

not to act as an 'escape goat' for irresponsible polluters of the developed world (CDM Executive Board, 2006).

“In the light of the failure of the US to honour its obligations to the agreements within the UNFCCC, let us hope that the ancient Brehon laws of Ireland do not prove to be too prophetic when they say there are three periods when the world dies: the period of a plague, the period of a general war, and the period of the dissolution of verbal contracts” (Begg, 2002:336). This unfortunately was a clear reflection on the previous Copenhagen Climate Change negotiations COP 15 in 2009, where no international legally binding agreement could be reached for the next commitment period of the Kyoto Protocol. The outcome of the COP was the Copenhagen Accord, to which only a few countries are signatories, including South Africa.

These crucial decision making moments of our time are failing to materialise the global agreements required to deal with this growing problem of GHG emissions. As pointed out by Böhringer (2003) the Kyoto Protocol constitutes the first and only international environmental agreement that builds on market based instruments to deal with the need for GHG mitigation. Clearly the observed trends noted by the IPCC, requires world leaders to establish more than this one legally binding agreement to deal with this global problem. The observed global trend of GHG emissions matches the predictions by the IPCC particularly in the FAR, and is reinforced by the TAR (figure 2.1). Countries involved in these debates need to take heed of the glaring evidence that is provided by the IPCC.

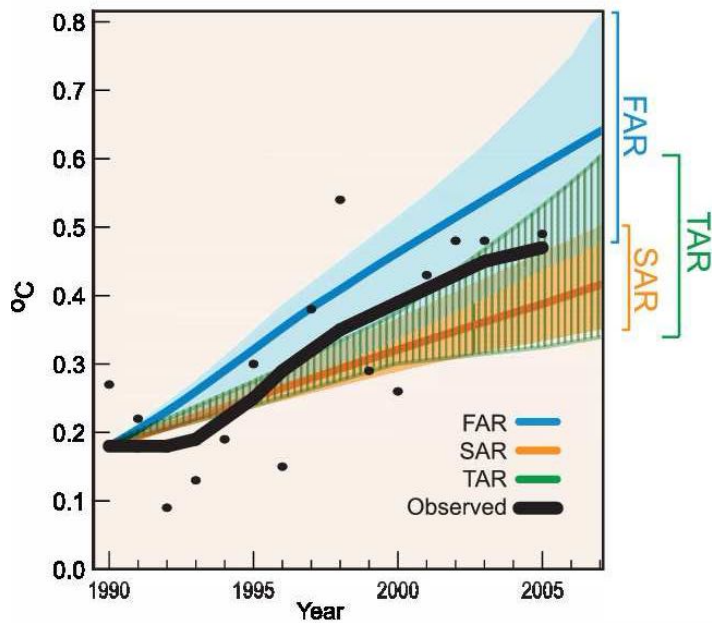


Figure 2.1 Predictions listed by the IPCC in the First, Second and Third Assessment Reports respectively (Stone, 2009:Slide1)

The IPCC is due to release their fifth Assessment Report in early 2014 which will allow for a clearer and more detailed representation of global atmospheric greenhouse gas levels. On 23 June 2010, the IPCC announced that 831 experts had been selected from among 3 000 nominations (IPCC Press release, 2010). The report aims to produce information that will aid in assisting countries to take action for reducing the negative effects of climate change. In light of this much anticipated fifth Assessment Report, a clearer account of carbon trading as an economic instrument is expected, and this is dealt with in the following section.

### 2.3 Carbon Trading

Philibert (2000) recognises that climate change is one of the most important environmental threats today and that an efficient, cost-effective international regime to face this threat through mitigation and adaptation is required. He puts forward the notion that this can only be achieved if the countries accept the principle of ‘common, but differentiated responsibilities’; and goes on to state that the development and implementation of sound economic instruments for environmental protection is the cornerstone of sustainable development which is nothing more than reconciling economic development and the environment. ‘Carbon Trading’ proposed by the Kyoto Protocol is such an economic instrument. This means that countries with

emission reduction commitments under the Kyoto Protocol can acquire emission reductions from other countries that either have reduction units to spare or from the countries that perform sequestration activities and build up a credit base. The agreement that has emerged from the UNFCCC and Kyoto Protocol has formally recognized the major influence of land-use management on GHG concentrations (Sandor *et al* 2002). Land-use management in the above context will not only make provision for net GHG removals but also influence conservation of natural environments, ecosystems and habitat management. The room created for conservation activities stated above is a step in the right direction but it must be recognised that the social well-being of the communities that depend on these systems goes ‘hand-in-hand’ with these concepts, and must not be ignored.

Project Standards such as the Gold Standard, Climate, Community and Biodiversity Standard (CCBS), can be defined as guidelines that aid in the implementation of carbon sequestration activities. They are a significant enabling step in the process to establishing, monitoring and verifying a carbon sink project on the global carbon market. “Of key importance, in addition to the successful integration of carbon sinks and emissions trading into other international treaties, is the development of practically achievable and objective standards and an efficient and transparent approval process consistent with the terms of the Convention and the Protocol” (Bettelheim and d’Origny, 2002:1827 – 1828).

These are yet to surface from the UNFCCC process, however a variety of project standards have been developed by the Voluntary Carbon market process. The CCBS, a globally derived standard that recognises the relationship between conservation of natural landscapes and the socio-economic well-being of society, is one such example. It outlines the need to balance the three aforementioned elements during a reforestation/ carbon sink project activity. “The CCB Standards foster the integration of best practice and multiple benefit approaches into project design and evolution, identifying projects that simultaneously address climate change, support local communities and conserve biodiversity” (Climate, Community and Biodiversity Alliance, 2008:4)

As mentioned by Sandor *et al* (2002) the objectives of the climate and biological diversity conventions are deeply inter-twined. This is recognised by the inclusion of biodiversity and community project proponents in the Climate, Community and Biodiversity standards (CCBA, 2005). More recently these linkages are highlighted in the subsequent COP meetings as an important step to reducing emissions and curbing, if not eliminating, deforestation altogether.

As stated in the Marrakesh Accords (2001) the IPCC was invited to take lead responsibility to elaborate methods to estimate, measure, monitor, and report changes in carbon stocks and anthropogenic greenhouse gas emissions by sources and removals by sinks resulting from land use, land-use change and forestry activities under Article 3.3 and 3.4, and Articles 6 and 12 of the Kyoto Protocol. As a result, the IPCC produced detailed reports such as the Good Practice Guidance for LULUCF (1996, 2003), which focused on providing implementation and reporting guidelines for LULUCF projects related to human-induced changes in carbon stocks and greenhouse gas emissions by sources and removals by carbon sinks.

Carbon trading markets are being globally developed specifically for the purpose of carbon trading. “The Chicago Climate Exchange is intended to provide an organized carbon-trading market involving energy, industry and carbon sequestration in forests and farms. These markets represent an initial step in resolving a fundamental problem in defining and implementing appropriate policy actions to address climate change.” (Sandor *et al* 2002:1889–1890). While this seems like a step forward, Philibert (2000) points out that economic uncertainty is a key factor during the negotiation period. It is therefore important to recognise the need for what he terms a ‘budget period’ as many developing countries will reconsider their negotiation standpoints in terms of legally binding commitments should there be high economic uncertainty. “In any event, the challenges associated with incorporating carbon sequestration into the GHG markets makes it likely that these markets will go through several iterations over the next two decades as experience is gained, as measurement technology improves and as market participation and value grows” (Sandor *et al* 2002:1891). Acknowledging these uncertainties in the markets Fearnside (2001) makes mention that if well negotiated, inclusion of forests can result in positive gains for global climate, in addition to advantages in other spheres. It is at this point the role of carbon sinks is explored in

greater detail. The mitigation potential of carbon sinks require a thorough evaluation and full consideration in the fight against the negative effects of climate change. This is dealt with in Section 2.4.

#### **2.4 The role of carbon sinks in climate change mitigation**

As mentioned by Ali *et al* (2010) carbon sequestration entered the realm of climate negotiations as a GHG reduction mechanism without a detailed broad market valuation of carbon. While the intention of carbon sequestration projects is to reduce GHG emissions, it must be recognized that forests play a fundamental role in this debate in many respects and the associated complexities must be recognized and respected. Brown *et al* (1996, 2002) states that forests play an important role in the global carbon cycle as they store large quantities of carbon in vegetation and soil, this is further supported by the Food and Agriculture Organisation (FAO) in its 2011 State of the World's Forest Report (FAO, 2011). The inter-relationship between the forests role as a source and sink indicates that there is a continuous exchange of carbon with the atmosphere and the biosphere through photosynthesis and respiration. Forests are sources of atmospheric carbon when they are disturbed by human or natural causes but become atmospheric carbon sinks during re-growth after a disturbance. According to the FAO (2011), planted forest cover increased in North and West Africa whilst creating nearly half a million jobs in the primary production of forest goods. While this is positive, the role of forest products in carbon storage is not addressed in the Kyoto Protocol and is currently being discussed under the UNFCCC.

Forests can be considered a fundamental building block in the planet's gaseous exchange cycles, in particular the carbon cycle. Tree size, age class structure, density and type of forest have a significant impact on the rate and sequestration potential of a particular forest. This is shown by McHale *et al* (2007), Phillips *et al* (1998); Bolin and Sukumar (2000); Malhi and Grace 2000 (cited in Brown *et al* 2009), where a cost efficiency study demonstrated that mature tree size was the third most important variable influencing cost effectiveness. Larger-stature trees stored more carbon and had a greater effect on the surrounding microclimate than smaller trees, indicating a sink strength of the order of 1 ha yr<sup>-1</sup> or less. This means that forests sequester carbon on an annual basis irrespective of their strength, density or age class structure

differences. Although it is not clear what the mechanism is for this sink, conserving tropical forests both avoids GHG emissions and sequesters additional carbon (Niles 2000; Chambers *et al* 2001; Brown *et al* 2002).

“The issue of carbon sinks has been controversial ever since its surprise inclusion in the Kyoto Protocol (Articles 3.3 and 3.4). Many methodological issues, such as non-permanence, additionality, leakage, uncertainties and socio-economic and environmental impacts, remain to be tackled by the UNFCCC’s Subsidiary Body for Scientific and Technological Advice and the IPCC in the years to come.” (Dessai and Schipper, 2003:151–152). It is the implementation and operation of such activities which will define the success of reducing GHG emissions through these mechanisms. It is noted by Sandor *et al* (2002) that despite the discussion and debate surrounding the inclusion of sequestration in GHG-mitigation efforts, there is relatively limited practical experience with sequestration crediting. The implementation of such activities or interventions has a two-fold practical and technical proponent. The first being the field implementation by the envisioned local communities and the second being the expert-driven technical, methodological and accounting proponents. To date there is no published standard South African methodology for the initiation, implementation and sustainability of such project activities, however one related project has been initiated in northern KwaZulu-Natal, the ‘Mkuze River Floodplain Carbon Sink project’, and will feature as the case study for this research (Ramanand, 2007).

“Carbon sinks provide a practical available method of achieving meaningful reductions in atmospheric concentrations of carbon dioxide while at the same time contribute to national sustainable development goals” (Brown *et al* 2002:1593). It is estimated that some 40% of carbon credits generated in the voluntary market come from tree-related projects (WRM, undated). McHale *et al* (2007) supports the notion that maintaining the highest survival rates and strategically planting trees where they have more influence on energy usage can make a project more effective. This was demonstrated by the Nagenahiru Foundation based in Sri Lanka, where a mangrove rehabilitation project was set-up under varying planting regimes. In the first scenario, the planted mangrove trees were widely spaced (1meter x 1meter spacing), while in the second scenario the trees were clumped together. Both scenarios were monitored

for one year. The second scenario proved to be the most viable planting regime, as it created competition for light amongst species which forced the trees to grow at a faster rate; while the growth rate for trees from the first scenario improved marginally over the one year period (Ramanand, 2007; Nagenahiru Foundation, 2007).

Apart from the planting regime issues, one has to consider the accounting issues especially at the project level so as to minimise the standard error. Carbon storage at the project level, or on discrete parcels of managed land, can be estimated with a much smaller standard error as many of the underlying uncertainties such as condition of the land and type of land use are resolved. This is especially true in managed areas where allometric equations are available to estimate biomass from measurements of height and diameter (LeBlanc, 1999). In the case of South Africa, several tree species specific allometric equations have been calculated and developed, and is reflected in work undertaken by Netshiluvhi and Scholes (2001). The IPCC and numerous other technical publications offer equations and default values that can be adapted to the project, although more South African species-specific allometric equations would be beneficial to the process (Netshiluvhi and Scholes, 2001).

“To have a significant impact, reductions over the next few decades have to be much greater” (Arnell *et al* 2002, Brown *et al* 2002:1595). For example, to stabilize concentrations of CO<sub>2</sub> at 550 parts per million (ppm) by 2150, a stated policy of the European Union (in comparison with current levels of 370 ppm; Keeling and Whorf 2000), carbon emissions will need to be reduced by 136 Gt during the next 50 years from a business-as-usual scenario. To ensure that the world is on the path for stabilization at 550 ppm, carbon emissions would need to be reduced by 8 Gt during the first Kyoto commitment period (2008 – 2012). This is emphasised by LeBlanc (1999:199) “including carbon offsets or credits from the land use sector is critical to the success of any greenhouse gas (GHG) emissions trading system designed to implement the United Nations Framework Convention on Climate Change (UNFCCC)”.

It is clear that the role forests play in reducing these GHG emissions is vital if we are to reach projected targets and goals. According to Brown *et al* (2002), objections to carbon sinks are based primarily on two arguments. First, sinks may allow developed

nations to delay or avoid technological adjustments to reduce their reliance on fossil fuels; and, second, technical and operational difficulties would reduce the value of sinks, allowing for inflated claims of carbon offsets. However, Fearnside (2001) argues that the role of tropical forests and forests in general will be recognized and incorporated into global warming mitigation measures as the logic behind the carbon benefits of maintaining tropical forests is scientifically sound. This is supported by the decision of the UNFCCC COP 15 as REDD+ has been recognised as a mechanism whereby the methodologies, operations and implementation aspects of mitigation through forests is being investigated at the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the UNFCCC (United Nations, 2010).

According to Brown *et al* (2002), significant global effort is required for carbon mitigation potentials to be attained. Technological change by developed countries must account for the largest proportion of emissions reduction, more than 60 percent; thus there is no escape from technological change through carbon sinks; there is no 'loophole'. This is highlighted by the Copenhagen Accord, where it is clearly stated that the parties recognise the crucial role of REDD+ and the need to enhance removals (United Nations, 2010). The Katoomba group who also created the REDD Opportunities Scoping Exercise (ROSE tool) is recognized by the United States Agency for International Development (2009). It is through the influence of this group that REDD+ projects are piloted in Ghana, Tanzania and Uganda where it is stated that similar policy and institutional approaches are essential for addressing the underlying drivers of deforestation, including issues around agricultural productivity and expansion, land and tree tenure, forest governance, land-use planning and subsidies.

While 'permanence' is a concern, carbon sink projects that continue to store or sequester carbon for the selected target period or beyond are 'permanent' for all relevant purposes. When the credits expire, the land is released from any further obligations; or the owner might decide to extend the project for another time period and be free to renegotiate. Once additionality has been demonstrated, a baseline or a projection of the 'business-as-usual' carbon emissions or storage needs to be developed for all mitigation projects.

The difference between the carbon emissions or removals of the baseline for without-project activities and the carbon emissions or removals for with-project activities represents the carbon value. Baselines can be established by projecting past trends and current situations to calculate the amount of carbon stored or emitted based on the conventional pattern of land use and forestry. It is stated by Brown *et al* (2002) that leakage is defined as the unanticipated decrease or increase in GHG benefits outside of a project's accounting boundary, as a result of the project activities. It is pointed out by Fearnside (2001:179) that, “although constructing baselines is not easy, it is also neither impossible nor inherently different from the problems with baselines in the energy sector”. While this may hold true for some countries, it must be noted that there is a need for immediate technical and implementation capacity in South Africa, if baselines are to be established for related projects. This further highlights that capacity building and technology transfer is essential for South Africa to fully participate in reforestation or REDD+ projects.

According to Brown *et al* (2002:1595 – 1596), LULUCF activities can mitigate carbon emissions by:

- (i) Emission avoidance through conserving existing carbon stocks on the land (e.g. avoiding deforestation, changing harvesting regimes, converting from conventional to reduced-impact logging);
- (ii) carbon sequestration or expanding the storage of carbon in forest ecosystems by increasing the area and/or carbon density of forests (e.g. by protecting secondary and other degraded forests to allow them to regenerate, restoring native through assisted and natural regeneration, establishing plantations on non-forested lands, and increasing the tree cover on agricultural or pasture lands); and
- (iii) substitute sustainably grown wood for energy intensive and cement-based products (e.g. biofuels, construction materials) (Myers and Goreau 1991; Brown *et al* 1996; Kauppi and Sedjo 2001).

According to Kobayashi (2004), the terrestrial biosphere is estimated to sequester approximately 2 billion metric tons of carbon per year, according to the estimate of the US Department of Energy. This alarming estimates illustrates the immediate sequestration potential of the Above Ground (ABG) and Below Ground Biomass (BGB) and the inherent long term capacity of the soil. “The Kyoto Protocol, together

with related initiatives being undertaken by national and local governments and the private and non-governmental sectors, provides the opportunity to incorporate the carbon-sequestration services realized through enhancement of carbon 'sinks'" (Sandor *et al* 2002:1892). Therefore carbon sink reforestation projects and REDD+ projects need to be taken seriously and the conservation, biodiversity and local community support 'spin-offs' that arise from such projects should not be ignored. Provided that start-up finance is attained in the early stages of the project, carbon-sink projects can provide the capital needed to help countries meet multiple national and local sustainable development objectives (Brown *et al* 2002). However, community 'buy-in' for the operational elements of such project ventures is required, hence one should place a strong emphasis on the planning and design stages that involves the community at all levels of decision making.

According to Brown *et al* (2002), there is no difference between carbon sink projects and other mitigation techniques, therefore carbon sinks can be implemented on existing principles and techniques while enhancing efforts to address climate change. Climate change mitigation projects work on the same principle, that is, to reduce GHG emissions, carbon sink initiatives have the same goal. Keeping this fundamental principle in mind, carbon sink projects should be designed to suit the local community dynamics, biodiversity concerns, and fulfill its role of reducing GHG emissions by improving the land's capacity to sequester carbon. "More carbon can be maintained in the forests than the amount of carbon credit granted. In this way, even if the carbon in the forests is temporary, at some point a net benefit exists for the climate from having the forest project instead of a smaller reduction in fossil-fuel emissions" (Fearnside, 2001:169). Sandor *et al* (2002) points out that the potential for carbon sequestration enhances land conservation and stewardship. Therefore it can be argued that the efforts to pursue the goals of the climate convention can represent the most important set of actions that advance the goals of socio-economic and biodiversity aspects of reforestation initiatives. In 1992 the United Nations noted the link between environment and development, and the imperative need for sustainable development was recognized worldwide, with the aspect of combating deforestation being one of the key areas of action (Thompson, 1997). As a result, the formal introduction of the convention on Biological Diversity was made in 1992 at the Rio Earth Summit that created a platform where forest related issues could be discussed.

Based on modeling techniques as mentioned by Hurtt *et al* (2002) it was found that without dramatic increases in the area of forests, without substantially positive changes in land-use practices, without large net positive effects of CO<sub>2</sub> or climate change in the future, or without some other new significant carbon storage mechanism, the U.S. carbon sink itself will decrease substantially over the 21<sup>st</sup> century. This predicted scenario is unfortunately at risk of becoming a reality as the U.S. is still not a ratified party of the Kyoto Protocol, remembering the U.S.'s withdrawal from the Kyoto Protocol in March 2001 (David Suzuki Foundation, undated). This will ultimately affect the livelihoods and dynamics of forest-dependent communities and threaten biological diversity.

### **2.5 Operation and implementation of carbon sink projects**

The world's carbon markets have evolved relatively fast while the operational implementation of carbon sink projects in South Africa has been relatively slow based on the fact that the country has just recently released its National Climate Change Response White Paper in October 2011 (NCCRP, 2011). South Africa is in the process of streamlining the implementation of its national policy on climate change, hence 'on the ground' implementation is yet to be realised. As noted by Sandor *et al* (2002) the UN process has introduced a framework for conducting international trade in GHG reductions and sequestration through pilot GHG market mechanisms. However, implementation is predominantly left to national governments who can make these mechanisms operational. It is important to highlight that the role of national and local government is significant when it comes to piloting these projects. The financial and technical aspects of such project generation must be funded in its initial phases either via government grants or external funding windows such as the World Bank, Global Environment Facility. Coupled with the initiation of such projects should be fully fledged and funded research that boasts an intensive and extensive scrutiny of such project implementation and the requirements for its success. This is an important step to ensuring capacity building in all spheres of the project. This will however require an extensive archiving system that will capture and store all the information one needs to fulfill the criteria, a Greenhouse Gas inventory (NCCRP, 2011)

“Experience to date has been limited to a few projects, and hindered by the lack of data, and short time-frames since project inception. Qualitative methods may need to be developed further, together with efforts to generate more-accurate data at the right level of definition” (Aukland *et al* 2002 cited in Brown *et al* 2002:1601). It is stated by Niles *et al* (2002), as far as mitigation in developing countries is concerned, planting trees is the only land-use option valid in the first commitment period (2008-2012). This applies to the more environmentally benign category of tree planting that includes natural regeneration, reforestation degraded lands and agro-forestry, and not plantations. Therefore, considerable effort needs to be placed into developing more detailed country-specific implementation guidelines for the creation or conservation of carbon sinks. This facilitates further specifications on already developed guidelines provided by the CDM and the IPCC. The first year of this commitment period has passed and there is still the need for ‘fine tuning’ and detailing of country-specific implementation guidelines for creation and monitoring of carbon sinks. In the language of the UNFCCC, Monitoring, Reporting and Verification (MRV), not only the action applied to reduce the GHG emissions but also of the support provided to do so (UNFCCC, 2011).

Carbon sequestration literature in the form of project standards such as the Climate, Community and Biodiversity Standards (CCBS) highlights issues of land tenure, it is brief, unclear and there is much room for confusion (CCBA, 2005). This is supported by Unruh (2008), as it is stated that an examination of the ‘on the ground’ land tenure prospects of carbon sequestration in Africa has not yet been described in the literature. Sathaye *et al* (1997) cited in Leblanc (1999) makes reference to a decision matrix when selecting carbon pools (Figure 2.2). The matrix takes into account the size of the pool, the rate of change and the direction of change in that carbon pool. For example, in afforestation or reforestation projects on marginal cropland, the trees and roots pool will be counted as the carbon in this pool, is expected to increase as a result of the project and it is the major source of credits claimed. It is expected that the direction of change of the soil pool (or the soil plus litter pools) will be positive. In this case, measuring the soils pool becomes discretionary and would only be required if credits from increased soil carbon are to be counted. This decision is important in reducing transaction costs and allowing the investor to determine if gaining additional carbon credits are worth the measurement costs (Leblanc, 1999).

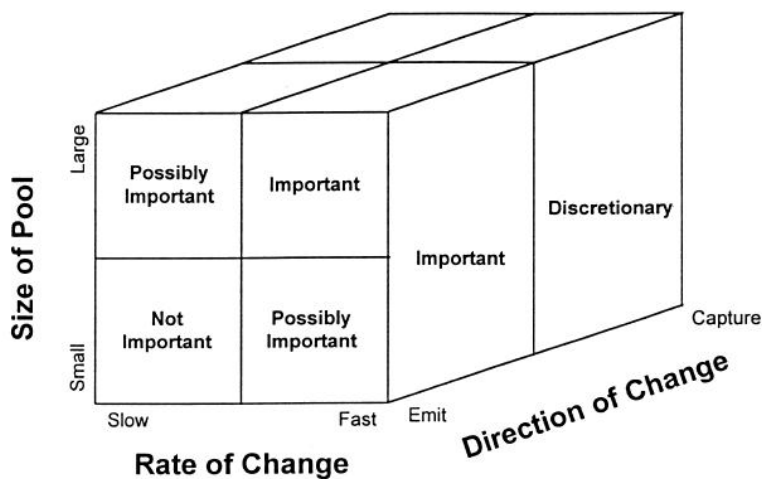


Figure 2.2 Decision matrix for carbon pool counting. (Source: LeBlanc 1999:204)

Fearnside (2001) points out that if LULUCF carbon benefits are real and adjusted in value to provide a greater benefit to climate than fossil-fuel carbon for each unit of CER, then it would be logical to use as much LULUCF mitigation as possible rather than restricting it. This is notwithstanding the fact that fossil fuel based economies must change simultaneously and not rely solely on the credits from the LULUCF sector to deal with this global climate crisis. At the same time, creating a space for the LULUCF sector to not only reduce GHG emissions but also enhance the livelihoods of forest dependent communities, biological diversity and environmental integrity. “If the US were to adopt the Kyoto Protocol, it would have to reduce emissions by 600 million tons in 2010. We calculate that roughly half of this requirement would result from reductions in domestic CO<sub>2</sub> emissions. Carbon sinks and the import of emission rights would account for the remainder” (Manne and Richels, 2004:452).

While Africa has contributed the least to climate change and yet will likely experience the most severe impacts, the continent has a great expanse of biophysically suitable land which could be used for placing carbon on landscapes via afforestation and reforestation projects (Toulmin *et al* 2005; Black, 2006 cited in Unruh, 2008). Besides the existence of the aforementioned project standards, there is currently no African and in particular, South African project guidelines for the implementation of carbon sink projects. Interesting to note that all carbon accounting procedures and inventory management are explained in great detail in most project design standards in the

CDM and the VCM market, however stakeholder participation lacks this standard of detail in both cases. Klooster and Masera (2000) argue that adequately designed and implemented, community forestry management projects can avoid deforestation and restore forest cover and forest density. This follows the idea of REDD+ projects which aim to avoid deforestation and degradation, while conserving community livelihoods and biological diversity. Unfortunately there are currently no national and country-specific design standards to initiate and implement such initiatives and international global standards are still in the process of being derived in the UNFCCC process.

## **2.6 Stakeholder Participation**

The science, technical procedures and focus of these reforestation carbon sink initiatives should be placed at the level of understanding and the involvement of local communities. This will enhance the understanding of the objectives of such projects. Friedman and Miles (2006) cited in Agbenyega *et al* (2009), define stakeholders as individuals, groups or organisations with an interest in a particular phenomenon, further distinguished according to the degree to which they can influence the phenomenon of concern. It is widely agreed and understood that such projects face numerous technical and implementation challenges. “Small-scale afforestation/reforestation projects under the Clean Development Mechanism of the Kyoto Protocol will sequester atmospheric carbon and facilitate carbon trading but they face significant implementation challenges among the rural poor households and communities that are meant to adopt and benefit from them” (Coomes *et al* 2008:207).

The main area of concern for most developing countries in relation to such initiatives, is the area of capacity building. Whitmarsh *et al* (2011) notes that although there is recognition of climate change on a global scale, there is a lack of emotional engagement with this issue. As a result, the area of capacity building lacks a significant amount of flexibility in terms of the manner with which it is undertaken. This is recognised by the international UNFCCC process, “There is no ‘one size fits all’ formula for capacity-building. Capacity-building must be country-driven, addressing the specific needs and conditions of developing countries and reflecting their national sustainable development strategies, priorities and initiatives” (The

Marrakesh Accords and Declaration, 2001:9). Capacity building is encompassing of the relationships that are formed amongst all partners and stakeholders, therefore the relational and constructivist learning approaches to related subject material must be explored within the context of capacity building. This enables a smoother flow of knowledge dissemination through the project process (Whitmarsh *et al* 2011).

Whether we are comfortable with it or not, carbon sequestration projects in the LULUCF and REDD+ arena are going to be viewed as fully fledged GHG mitigation activities. It is therefore our collective responsibility as a global society to ensure that the design and monitoring standards used are of the highest environmental integrity (UNFCCC, 2011). This is supported by Philibert (2000), as it is stated that enhancing the environmental performance at a given cost is our responsibility to those who suffer the most from a damaged environment: the poor, and the future generations. This will require the evaluation of social, environmental and economic relationships and how they can be manipulated to ensure the consideration of these three elements in conjunction with the needs of all stakeholders involved. A sound understanding of balancing social, economic and environmental needs is required when attempting to maintain the environmental integrity of an ecosystem (Ravnbord and Westermann, 2002; O'Brien, 2004 cited in Agbenyega *et al* 2009). This relates to the effectiveness of stakeholder participation as it takes into account the basic elements of sustainability that govern elements of what is known as sustainable livelihoods.

In addressing the challenges of reducing GHG emissions, it must not be forgotten that it is society as a whole that holds this responsibility. More often than not, participating agents and organisations are required to collaborate with local communities and indigenous people to initiate and maintain project activities in key areas. It is therefore important to acknowledge and nurture the relationship amongst these key stakeholders so as to maintain project activities and ensure that they are successful in addressing socio-economic needs at all spheres of the project cycle. Coomes *et al* (2008), argues that careful assessments are required from the rural household perspective before concluding that CDM-AR projects provide a viable path for carbon sequestration, forest restoration and poverty alleviation. This argument is substantiated by a study conducted in eastern Panama, which concluded that although reforestation would sequester significant quantities of carbon and enable the community to trade in

Certified Emission Reductions (CERs), the economic costs and risks are prohibitive, particularly when compared to the best alternate land use, under prevailing economic conditions and the terms of the CDM (Coomes *et al*, 2008). These arguments serve to strengthen the fact that socio-economic dynamics must be taken into account when establishing projects of this nature. It is noted by Vaughan *et al* (2009) that the required stabilization level is generally estimated to be approximately  $500 \pm 50$  ppm, with the range encompassing uncertainties in both human and system behaviour, and in the levels of current understanding. Evidence provided by Whitmarsh *et al* (2011) shows that GHG emissions, carbon in particular, is rarely related to personal actions in society and as a consequence few people take significant steps to leading a low carbon lifestyle. Changing human behaviour and activities is key to achieving project success and ultimately the reduction of GHG emissions (Markowitz and Doppelt, 2009).

“Projects that do involve community ownership through financial investment or managerial control by or on behalf of groups of ‘members of the public’ have achieved this to different degrees and in different ways” (Stamford, 2004 cited in Walker, 2008:4401). While Klooster and Masera (2000) demonstrate, in the case of Mexico, community forest management is especially effective as it offers tangible local benefits while conserving forests and sequestering carbon. Walker (2008) discusses several models of community ownership that can be considered when including communities in project work. These include; cooperatives, community charities, shares owned by a local community organisation and development trusts. The World Bank (1995); Klooster (1999); Bray and Wexler (1996 cited in Klooster and Masera, 2000:259) suggest that, “community-based forest management has an important role to play in reversing processes of deforestation, sequestering carbon, and promoting rural development”. However, it must be noted that this management regime does require a degree of technical, educational and management support. Potvin *et al* (2007, cited in Coomes *et al* 2008), predicts that without the Clean Development Mechanism – Afforestation Reforestation (CDM-AR) project, carbon stocks will decrease from 301 859 tons of carbon (tC) in 2004 to 155 730 tC in 2024.

The underlying potential of this type of sequestration activity has spurred numerous forest project activities or pilot projects across the world, including South Africa. This

is reinforced by Brown *et al* 1996 cited in Klooster and Masera (2000) asserting that slowing deforestation and promoting forest regeneration could sequester 12 – 15 percent of expected emissions by 2050. Walker (2008) highlights the benefit of *developer incentives*, stating that some developers are starting to engage in innovative co-ownership models as they recognise the need to address the imbalance between the local impacts and benefits of project development. “Our financial analyses reveal that avoided deforestation, whereby residents would be compensated in return for forest preservation is a promising alternative compared to pasture and cattle raising” (Coomes *et al* 2008:209).

While Coomes *et al* (2008) highlights the significance of avoided deforestation, it must be noted that the greatest challenge currently facing the planet is shortage of sink potential; and reforestation activities is a required component of mitigation against climatic change. This is particularly true for low forest covered developing countries who wish to participate in the CDM- AR or voluntary forest carbon projects, however a large parcel of land is required on which to initiate such project activities. Community participation is key to the success of increasing the planet’s ‘sink potential’. According to Klooster and Masera (2000) the participation of the people who inhabit forest regions helps generate effective enforcement structures and facilitates the evolution of adaptive management as forest dwelling communities often have strong ties to the forest and value highly its future productivity. Through a review of different community ownership models, Walker (2008) recognises the need to involve urban communities in projects. Part of the solution to wider diffusion is to involve urban environments and populations.

Urban tree planting has recently featured as a viable ‘greening’ option to offset emissions from other project activities. This is explicitly explored by the government of South Africa, as numerous projects related to greening the 2010 FIFA Soccer World Cup were initiated. As stated by Diederichs *et al* (2009) the Buffelsdraai Landfill Site is the first municipal reforestation project to replant a forest in previously sugar cane land, in the city of Durban. These types of projects have embraced the involvement of community members and in so doing, enhanced the value of such projects by partnering with the local community (Project2010, 2010 and eThekweni’s Green Guideline series, 2010). This is supported by Klooster and Masera

(2000) who state that with the active participation of resident communities, forest management becomes a strategy that provides both mechanisms and incentives for communities to conserve forests, while meeting local development needs. It is important to recognise not only the value of local communities' participation but also the link of social dynamics to project related activities as criteria to achieving a successful project. This is noted by Saunders *et al* (2002:1763) "for carbon trading to develop social capital from natural capital requires the admission of forest communities into the polity and management of forest resources". This will require an inclusion of indigenous peoples' rights, knowledge and local communities into global and local policy and management regimes.

### **2.7 Local setting, South Africa**

South Africa does not have a large area of indigenous forest cover as compared to the South American, Central African and Asian parts of the world. However, indigenous forests cover is 400 000 hectares and Woodlands cover is 23 million hectares in South Africa, making carbon sequestration efforts a viable option. "The National South African Forest Act of 1998 defines forest to include woodlands, plantations and natural forests" (Republic of South Africa Government Gazette, 1998:5), however, it does not go further to define the size, distribution and area cover within this definition. This affects the information base on the link between carbon sequestration potential and forest type. As identified by Lal *et al* (2000), the link between tropical ecosystem carbon and climate change is approximately 15 percent of the present net human impact on global greenhouse gas budgets, and is estimated to originate from land use changes in the tropics. "UK forests represent an annual sink of about 2.7Mt of carbon, or about 1.8 percent of annual current UK carbon emissions. Hence carbon sequestration can strengthen the case for multi-purpose woodland creation" (Agbenyega *et al* 2009:555). It can therefore be deduced that land use change by human intervention is inadvertently a major driver for the increase or natural imbalance of GHG emissions. The responsibility to reduce these emissions, lies with the human population themselves and coupled with the vision to reduce GHG emissions, is evidence of strong potential that reforestation initiatives can, if managed correctly, aid in achieving the reduction of GHG emissions. South Africa has recently embarked on creating and publishing a climate change policy that attempts to deal

with the reduction in GHG emissions. One of the sectors closely looked at is that of forestry, both commercial and indigenous. This is a step in the right direction considering the global goal of reducing GHG emissions (National Climate Change Response Green Paper, 2010).

“Today, the environment is rightfully the concern of big business as well as NGO’s, government and community based organisations” (Skyworld, 2008:34). This is supported by the fact that 59 of the Johannesburg Stock Exchange’s (JSE) top 100 companies participated in the Carbon Disclosure Project, which is considered high by international standards (Tulleken, 2009). Even though this is the case of the current business environment in South Africa, Andre Fourie, chief executive officer of the ‘Carbon Disclosure Project’ warns that “there is still insufficient evidence to suggest that mainstream South African investors fully appreciate the business implications of climate change, or that they are exerting meaningful influence on the corporate sector on this issue” (Tulleken, 2009:116). Little attention has been paid to the development of national policies relevant for the uptake, development and implementation of CDM projects (Minang *et al* 2007), and major technical and capacity building investment. This is emphasised by van der Merwe, (2008 cited in Unruh 2008), where it is stated that of the 1 090 projects of all kinds (not only afforestation and reforestation) in emerging countries, only 25 are from Africa and 11 of these are in South Africa. This lack of progress is exacerbated by the fact that South Africa has minimal technical expertise, and has only begun to explore the ideas of mass capacity building regarding the nature of reforestation programmes (FAO, 2002).

While this is the case for forest carbon sequestration-related reforestation and rehabilitation initiatives, a recent survey conducted across 21 countries, by the research firm Synovate revealed that more than two-thirds of the world is concerned with climate change. South Africa is emerged as one of the most concerned countries with 82 percent of the respondents presenting ‘very concerned’ responses (Tulleken, 2009). This is a promising result for South Africa as it illustrates the level of awareness and this must be carried forward to a level of consciousness. The consciousness being referred to here is one that will afford society the realisation to ‘step out of the box’ and invest in a ‘greener’ world. “Most human experience and most human achievement has taken place in societies in which very little oil, gas or

coal is used” (Lohmann, 2006:20). It is important for society at large to realise the potential that exists in the simplicity of sustainable living. “The total amount of carbon that could be sequestered by reforestation to create native forests over the ten-year period (2003–2013), is 316 million tonnes on 3.5 million hectares of land. The greatest potential exists in countries of Latin America (56 percent of the total), followed by Asia (30 percent of the total) and Africa (14 percent of the total)” (Niles *et al* 2002:1626).

The carbon accounting for reforestation projects can become complicated especially with the lack of country-specific information. According to Niles *et al* (2002), rates of carbon accumulation are poorly known for many parts of the world and there is a considerable range in estimates. As a result, the approximate carbon sequestration potential for South Africa for the time period 2003–2012 was calculated to be 2.8 MtC over 100 000 hectares per year, at 19 million United State dollars net present value. “The TAR of the IPCC confirmed earlier findings that emissions avoidance and carbon sequestration by changes in the use and management of forests can make a meaningful, if limited, contribution to reducing atmospheric CO<sub>2</sub>” (Brown *et al* 1996; Kauppi and Sedjo 2001 cited in Niles *et al* 2002:1621). It is evident that reforestation can make a significant contribution to the reduction of GHG emissions through sequestration, and is shown by Niles *et al* (2002), where the mitigation category allowed in the Kyoto Protocol, appears able to sequester just over 0.3 billion tonnes for a total value of around 2.1 billion dollars.

It is also mentioned by Niles *et al* (2002) that 23 African countries, including South Africa, hold great potential for natural forest restoration that would allow for net economic benefits under the first commitment period of the Kyoto Protocol. South Africa has the potential to sequester 0.1 MtC which could yield a net value of 900 000 US dollars between the period 2003 - 2012, which translates to a halt in deforestation of 800 ha annually (Niles *et al* 2002). However, it is sad to note that it is envisioned these potential estimates may not be reached this decade unless there is support from national and international policy frameworks. For any of these potentials to be realized, there will need to be novel markets and effective policy mechanisms for ensuring sound implementation of land-use practices that conserve or sequester carbon (Niles *et al* 2002).

Apart from forest management and reforestation programmes imparting benefit to the reduction of GHG emissions, socio-economic and biodiversity will be co-benefits of such project activities. Klooster and Masera (2000) support this by mentioning that forest management has the greatest potential for carbon mitigation in the land use sector and could deliver rural development and biodiversity co-benefits. This is supported by the fact that if properly managed, reforestation projects are able to deliver greater socio-economic benefits. “A manifestation of this disconnect in an afforestation and reforestation project context is the assumption that the benefits accrued through forest projects on community land will outweigh the local economic, social, political, and security benefits of the same land under its current use, and that as a result community participation will be forthcoming” (May *et al* 2003; Silver *et al* 2000; Brown *et al* 2001 cited in Unruh 2008:702).

According to the Department of Water Affairs (2012) South Africa signed the Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests at the Rio Convention in 1992. As a follow-up, South Africa started developing a forest policy that embraced the Rio principles. “The basis for this transformation has been the formulation of new forest policies and legislation since 1994. By 1997 the new Government had reviewed its policies in terms of a new White Paper and developed the National Forestry Action Programme. In 1998 this was translated into the National Forest Act which set out new legislation based on the premise of sustainable forest management” (Department of Water Affairs, 2012:1). As a consequence Participatory Forest Management (PFM) in the Forestry directorate of the Department of Water Affairs materialized as the new integrated approach to promote sustainable forest management in South Africa. Therefore the importance of PFM practices must not be forgotten or underplayed in the initial development stages of implementing carbon sink reforestation initiatives / programmes at a national scale.

Niles *et al* (2002) states that, over the next 10 years, 48 major tropical and subtropical developing countries have the potential to reduce the atmospheric carbon burden by approximately 2.3 billion tonnes of carbon. South Africa is recognized as a developing country and needs to take into account the multifaceted benefits this specific mitigation activity provides, which include a reduction in GHG emissions, an

increase in carbon stocks, biodiversity conservation and improved community participation and benefit. Taking into account that adequate capacity and resources will be required to support such mitigation initiatives and PFM practices must be retained throughout the project process. These elements must form part of the initial phases of all reforestation initiatives as they will strengthen the credibility and sustainability aspects of reforestation initiatives.

## **2.8 Conclusion**

This chapter highlights the inherent potential for reforestation projects and programmes in addressing the challenge of climate change. This, however, is not an easy task as numerous integrative elements are responsible for the success of such project activities. These include stakeholder engagement, technical aspects such as carbon calculations, and most importantly the participation of individuals that are directly affected by these project activities. “Humans have the potential through changes in forest land use and management to alter the magnitude of forest-carbon stocks and the direction of forest-carbon fluxes, and thus alter their role in the carbon cycle” (Brown *et al* 2002:1594).

Taking into account the information presented by Brown *et al* (2002) one can deduce that there are two interpretations. The first being that forest-dependent communities alter carbon stocks through their usage of the forest resources thereby decreasing the stocks; and the second being that the communities that are either dependent on forests or living nearby forests can alter the carbon stock of forests by conservation and reforestation, thereby increasing the stocks. By choosing to do the latter, the spin-off socio-economic and biodiversity benefits are accounted for.

It has been demonstrated by Brown *et al* (2002) that carbon sinks, unlike most other mitigation strategies, offer opportunities both to reduce CO<sub>2</sub> emissions through avoiding further deforestation and improving forest management and to remove atmospheric CO<sub>2</sub> through establishment of new forests on marginal lands or protection of secondary forests. As carbon-sink strategies can be implemented relatively quickly as little new technology is needed, they readily lend themselves to local adoption and diffusion to the rural poor. As mentioned by Fearnside (2001), biodiversity maintenance is an important benefit of avoided deforestation that is not

attained by other mitigation measures, and if we wait until after the Kyoto Protocol first commitment period in 2013, there would not be much tropical forest left to save. This is fittingly supported by Johnson and Heinen (2004), who assert that although carbon trading is still a low-volume affair, the precedents and rules established now will have a significant effect in a few years. The devil is in the detail, but so are the angels.

## CHAPTER THREE

### Study Site

The chapter provides a contextual background to the study area of KwaJobe, including the location of the study site, the biophysical elements, community demographics, the sample population, and socio-economic status of the community. It also provides an overview of the history of the Mkuze River Floodplain Carbon Sink project and details the steps taken to establish the project.

KwaJobe is a deep rural community located on the far northern borders of KwaZulu Natal, South Africa. The Kwajobe community, have worked closely with the Wildlands Conservation Trust (WCT) in the past, and developed a good working relationship with WCT. Projects included community tree propagation and environmental education. As a consequence the community was familiar with the conservation values of the WCT, and began to place further importance and value on their own natural surroundings which included the riverine forest along the floodplain on the Mkuze River. When approached to participate in the Mkuze River floodplain carbon sink project, the community immediately took up the opportunity as they felt strongly about conserving their natural environment. At this point, it became clear to the WCT that piloting a community reforestation carbon sink project in the KwaJobe area was a tangible possibility.

This is South Africa's first attempt to creating a community carbon sink project and the community was willing participants. As a result, the implementation of the Mkuze River Floodplain Carbon Sink project was a step towards creating South Africa's very first carbon sink project by expanding the carbon storage on the floodplain through a reforestation initiative. Due to the fact that the Mkuze River Floodplain Carbon Sink project is the first of its kind for South Africa, it was chosen as the study site for this project. "This week the KwaJobe community with the help of the WCT planted the first of hundreds of thousands of trees along the Mkuze River floodplain. This will form what is scientifically known as a carbon sink, a concentration of newly planted vegetation that will offset the stripping of vegetation, and excess burning of fossil fuels in other parts of the world" (Wildlands Conservation Trust, 2007:par 3).

### **3.1 Location**

The study site is located in the KwaJobe community area, located along the north eastern border of the Mkuze Game Reserve in Jozini, Ward 3, which forms part of the Isimangiliso Wetland System. The wetland system stretches across approximately 450 km<sup>2</sup> of the coastal region of KwaZulu-Natal. Due to its location (Figure 3.1) the wetland system and the KwaJobe area are environmental heterogeneous areas that are surrounded by pans, streams and swamps. An indication of its species richness is the fact that there are 88 mammal, approximately 80 reptile, and 30 amphibian species recorded in the area (UNESCO, 2012). The study site is located 40 km west of the coast of KwaZulu-Natal with an altitude range of between 50-450 meters (m) above sea level (Ellery *et al* 2003). The socio-economic census information available for the KwaJobe area is limited due to a lack of updated South African census data.

#### **3.1.1 Geographic Reference**

The location of the Mkuze River Floodplain Carbon Sink project study site is provided (Figure 3.1 and 3.4), whilst its surroundings, the gradient and landscape level topography is evident. The KwaJobe area is situated on a relatively flat gradient while the surrounding areas are undulating. Whilst the flat gradient provides a fertile and manageable foundation to establish trees, if the Mkuze River floods this can be of concern to this community and for the reforestation project as both are located on the floodplain of the river. The project area itself follows the course of the river for a distance of approximately fifty km as indicated by the thick yellow line in the locality maps (Figures 3.1 and 3.2). A 3-dimensional map is provided to supplement the locality maps (Figure 3.4).

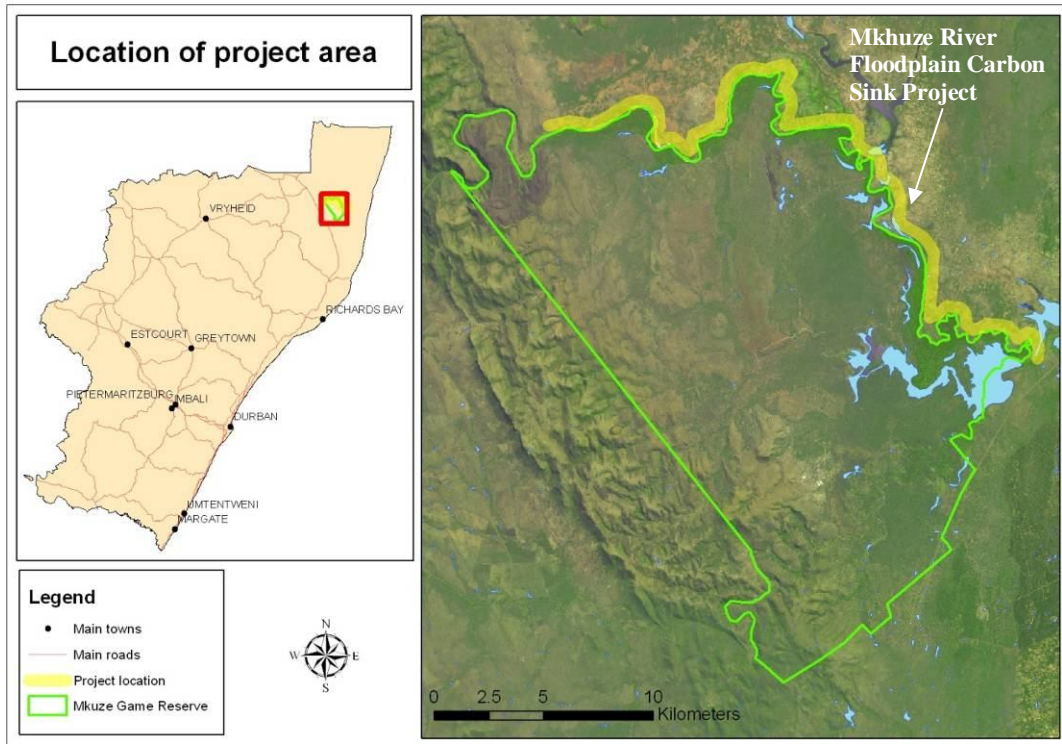


Figure 3.1: Locality map of the study site and the surrounding Mkuze Game Reserve. The surrounding undulating topography and floodplain is shown in the location map. (Ref: Dye, 2010)

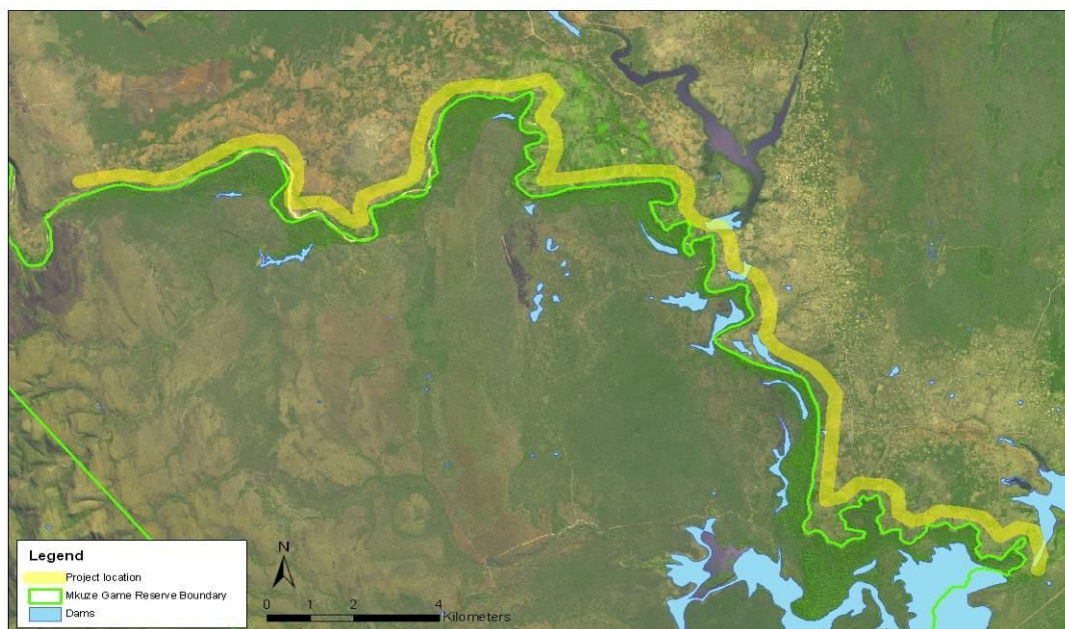


Figure 3.2: The project area boundary. The yellow line present on the map is an indication of the project site and follows the course of the Mkuze river (Ref: Dye, 2010)

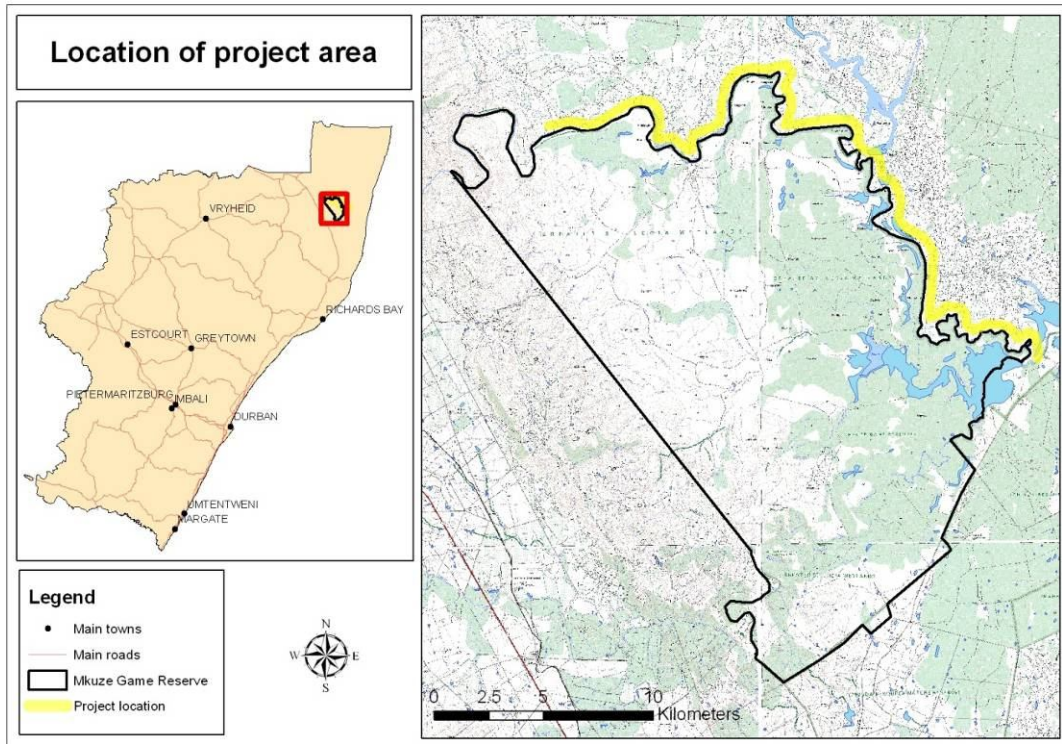


Figure 3.3: Topographical map of the study site and surrounding areas. (Ref: Dye, 2010)



Figure 3.4: A 3-dimensional representation of the gradient and landscape level topography of the study site and its surrounding areas (Ref: Dye, 2010)

## **3.2 Biophysical Characteristics**

### **3.2.1 Climate**

The study site experiences a sub-tropical climate that experiences a distinct rainy season which ranges from spring to early winter (October to March) with the winter months receiving less rainfall than those of the spring and summer months (Goodman, 1981). The average annual rainfall for the study site and its surrounding areas (Zululand) is 680 millimeters (mm), whilst mean temperatures for summer range from the high 20<sup>0</sup>C to the lower 30<sup>0</sup> C. The Mkuze River catchment is the region's water supply, with most of the region experiencing seasonal water flow periods. However, according to Gush (2000), there are distinct dry seasons such as June, July and August where rainfall drops below 5 mm during drier climatic periods. The sporadic and unpredictable nature of the rainy and dry seasons adds an element of complexity to reforestation projects as seedlings require water on a regular basis.

### **3.2.2 Vegetation**

The landscape can be described as undulating with a low to medium gradient (Figure 3.4). The project site falls within two major regions; the Indian Ocean Coastal Belt and Sudano-Zambezi Region (Goodman, 1990). The vegetation type can be classified as Zululand lowveld with numerous grassland species and low valley bushveld (Mucina and Rutherford, 2006).

The surrounding area (the Mkuze Game Reserve) and parts of the KwaJobe area boast nine major vegetation types; Dry Mountain bushveld, Mixed bushveld, Microphyllous Thorny Plains bushveld, Red Sand bushveld, Thicket, Sandforest, Grasslands, and Riparian fringing forest and savanna woodlands: (a) streambed and drainage line woodland (b) riverine forest and woodland (Mucina and Rutherford, 2006). The specific vegetation type surrounding the study site is that of riparian fringing forest. However, the land that has been used in the Mkuze River Floodplain Carbon Sink project can be categorized as degraded abandoned farm land, which was once covered by riverine forest and woodland. It is important to note that each of these vegetation types sequester carbon at different rates and have underlying implications for carbon sequestration projects. This is supported by England *et al* (2006:2) where a "National Carbon Accounting Toolbox (NCAT) was developed to predict amounts of carbon stored in vegetation, and it was found that rates of carbon sequestration varied being

highest in farm forestry plantation sites and least in natural regeneration sites”. Different species of trees and vegetation types will have varying growth rates and, as a consequence, affects the rates at which carbon is trapped in the specific vegetation type. Other consequences of a diversity of vegetation types include timing of planting, rates of survival, density of woody species, crown diameter and height, and all will affect the sequestration potential of the vegetation type and should be taken into consideration.

### **3.2.3 Water Bodies**

The study site is on a floodplain and is surrounded by two rivers, the Mkuze and Msunduze Rivers with swamps / pans in the study site and surrounding areas. Due to the seasonal water availability and distribution, these swamps and pans are rarely at their full capacity for long periods of time, causing water shortages on a regular basis (Gush, 2000) which have a direct effect on reforestation projects. In the case of the Mkuze River Floodplain Carbon Sink project, the Mkuze River is the only access point to water, therefore potentially creating difficulties when river capacities are low. As a result the lack of surface water does have a large influence on the project, by influencing the timing of planting, as the lack of water makes it difficult to provide supplementary watering to the planted trees, therefore tree planting is restricted to periods when there is rain (Wildlands Conservation Trust, 2007).

### **3.2.4 Geomorphology**

The surrounding areas include a variety of topographical features such as hilly undulating areas which consist of Jozini Rhyolite Formations, early and late Cretaceous sediments and the low lying flat alluvial floodplain. The soil structure is sandy loam to hydromorphic grey soils as the parent material has weathered to form predominantly silt and clay (Goodman, 1990). The study site rests upon the latter, the low lying alluvial floodplain (Figure 3.4) and is situated on a relatively low lying gradient sloping from 0 to 2 degrees, providing an easily accessible landscape for community participants to plant trees.

### **3.2.5 Biodiversity**

According to UNESCO (2012) the surrounding Greater Isimangiliso Wetland Park, serves as a world heritage site as it belongs to the Maputaland-Pondoland-Albany

hotspot in South Africa, The region extends along the east coast of South Africa, north towards Swaziland and Mozambique. It houses a variety of plant and animal species, of which approximately 60 species are endemic to the province of KwaZulu-Natal.

“The Maputaland-Pondoland-Albany is an important center of plant endemism, and the second richest floristic region in Africa after the Cape Floristic Region” (UNESCO, 2012). In the broader context, 108 species are endemic to South Africa. According to Combrink and Kyle (2006) 467 species are listed on the red data list, as they are deemed threatened. Unfortunately this region is under threat from a number of anthropogenic activities such as urbanization and cultivation, which threaten the region’s floristic kingdom. As a result the Department of Environmental Affairs in South Africa is establishing transfrontier conservation efforts that aim to link nature reserves bordering Swaziland and Mozambique to protect the floristic region. This is also an important step for carbon sink projects as biodiversity conservation of forest systems is inherently linked to carbon storage. This is further supported by Diaz *et al* (2009:55) where it is noted that “biodiversity of forested ecosystems has important consequences for long term carbon storage, and thus warrants incorporation into the design, implementation and regulatory framework of mitigation activities”.

### **3.3 Community demographics**

The northern part of KwaZulu-Natal (Zululand) falls within the Umkhanyakude District Municipality. A 2001 Census (StatsSA, 2005) state that Jozini had a total population of 12 826, of which 5 742 are males and 7 094 females. The most recent census data could not be retrieved for the area. The area has seen a population growth of approximately 30 000 inhabitants in recent years (the Department of Economic Development KwaZulu-Natal, 2006), and this has had an effect on resource utilization as the majority of the population are involved in subsistence farming activities. The resources in the area, such as wood from the forest, are used for fuel wood, pole fencing for demarcating farms, housing and medicinal purposes. As pointed out by the Wildlands Conservation Trust (2007) the utilisation of wood has not had a negative effect on the project. According to Koaleli (1999) the main source of external income is sourced from grants and remittances. The main language spoken in the area is isizulu.

### **3.4 Project History**

The Mkuze River Floodplain Carbon Sink project was initiated by an NGO, the Wildlands Conservation Trust in 2007, whose core business is conservation and biodiversity preservation. As the implementing organisation, WCT chose the KwaJobe community as they had previously established trust and a good working relationship with the community. The organization met with all relevant stakeholders involved, that is, the sponsors and donors of the project, local traditional leaders, all ward councilors, the adjacent game reserve managers and members of the local community. The project was internally funded by the organization with the aid of donor funding in the form of grants from the Rand Merchant Bank (RMB) Foundation and the DG Murray Trust through the Climate Action Partnership (Wildlands Conservation Trust, 2007). The WCT manages all aspects of the initiative from high level planning and fundraising to facilitating and monitoring work on the ground.

The sections below describe the project implementation, focusing on aspects of stakeholder engagement, sampling methodologies, data gathered and carbon calculations.

### **3.5 Field Work**

The field work described below was undertaken by the researcher on behalf of the WCT; the data gathered is reflected in the study with the permission of the WCT and is the intellectual property of WCT. The work involved undertaking community workshops, ground truthing exercises; desktop mapping; vegetation, tree and soil sampling and analysis; as well as carbon calculations. The field work detailed below does not constitute a formal part of this study. It is included as it sets the scene for this study and aids in bringing to the fore the complexities that exist in implementing projects of this nature. It has also aided significantly in the creation of an applied guideline for the South African situation.

#### **3.5.1 Community Workshops**

After consultation with community leadership, community meetings were held to explain the reforestation concept to prospective participants of the Mkuze River Floodplain Carbon Sink project. A series of community workshops, attended by approximately 400 people, were held in five sub-divided communal areas, namely

Ward one to five, three months before implementation, to introduce the project concept to the local community. Due to the fact that there was no infrastructure to accommodate the large numbers of people that attended the workshops, the workshop material was presented to the community members in open fields and school premises in the community area (Plate one). In general the workshops were well received. This is in accordance with Rahlao *et al* (2012), who support the fact that establishing such projects on traditional communal owned land in South Africa requires a lengthy stakeholder engagement process.

The workshop material was presented to the communities through a verbal presentation and an interactive sustainable development ‘game’ designed by the researcher (Plate two), including an explanation of climate change, how forests act as the ‘lungs’ of the planet and the balance between the economic; social and environmental spheres of development (Plates two and three). The interactive sustainable development game was used with project participants as well as general community members to create a more relaxed and personal relationship with the community, whilst opening up communication channels for a dialogue between the researcher and the community regarding environmental issues. The game was played with both project participants and non project participants so as to involve the community in the workshops in a holistic manner. The procedure and rules of the game is as follows:-

**Procedure:** there are three dimensions, namely, social, environmental and economic which include three issues each that is attached to these three dimensions. A string is attached to all these dimensions and is tied around a ring in the centre. A cylindrical shaped plastic pipe is a separate piece of the game and it is placed on the opposite end of the classroom from which the pupils are. A tennis ball is then placed on the top of the ring that is attached to the three dimensions. Each group of people of about nine or ten members is given a number from 1 – 4, this number also corresponds to one of the 4 cylindrical shaped plastic pipes. The idea of the game is to then place the tennis ball on the ring and find the corresponding cylindrical shaped plastic pipe and move it to where the pipe that corresponds to their group number is and then place the tennis ball on that pipe. That marks the end of the game.

**Rules:** Game participants (community members) were not allowed to use speech as a form of communication during the game; if the tennis ball drops during the game the group must then begin again from their start position and continue until they are able to place the ball on the pipe. They were also not allowed to move any obstacles out of their way but instead have to find a way to walk around the obstacle without dropping the tennis ball.

**Significance of the game:** the ultimate aim of this educational game was to bring to the attention of community members that the three elements that are housed by the framework of Sustainable Development, that is, environmental, social and economic elements, must aim to work together in order to achieve development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The “no communication through speech” rule was made to afford community members the opportunity to explore other avenues of communication, as well as to show participants that without effective communication amongst all parties involved, it is hard to achieve any goal in the minimum amount of time required. The introduction of obstacles was done to show the game participants that when trying to achieve anything in life, they must encounter obstacles and find a way to work through or around them. The procedure and rules of the game was then explained to the community members. They then proceeded with the game once they had an understanding of what to do.

After the game was played, the community members were asked what they had thought of the game, field notes were taken, and the significance of the game was then explained to the participants. A chart (Plate One) that was designed by the researcher was also used as an explanatory mechanism to involve the community members in conversation about the specific issues that they were presented with during the questionnaire as well as the educational game and to highlight the research being done and; field notes were also taken during this time to supplement the data that was collected during the interviewing process.

At the time of project initiation, WCT had an active presence in the Kwajobe community through the locally successful ‘Indigenous Trees For Life’ (ITFL) initiative, which involves the propagation of trees through local community

participation. The KwaJobe community was involved in the ITFL project, germinating trees from seed and bartering the seedlings/saplings with the WCT for goods that were donated by the WCT partners, such as food, clothing and school goods (Wildlands Conservation Trust, 2007). WCT therefore had credibility in the area and was trusted by the community allowing for positive initial interactions. The existing relationship therefore allowed for easier communication with the community members during the workshops. The community was originally sceptical of the Mkuze River Floodplain Carbon Sink project and hence only a few community members participated, however, after monetary and social benefit flowed to the project participants, interest and support for the reforestation project grew.



Plate 1: Explaining the significance of the sustainable development game to the local community.



Plate 2: Community Workshop in KwaJobe with non project participants, making use of the Sustainable Development game



Plate 3: Community Workshop in KwaJobe with project participants, making use of the Sustainable Development game

### **3.5.2 Mapping**

Once permission to undertake such a project was provided by all stakeholders, a ground truthing exercise was undertaken which later involved the mapping of the study site on a Geographical Information System. An on the ground mapping and survey exercise was undertaken both in a mature forest patch and at every potential planting site of approximately two hectares in size.

#### **3.5.2.1 Mature Forest**

Two approaches were considered when deriving a forest sampling strategy, (1) running a supervised classification of land cover types that allowed signatures to dictate the presence of indigenous vegetation cover where the researcher would choose random sampling locations; or (2) the most recent available land cover data layer was overlaid on the most recent available SPOT imagery of the study site. Visual interpretation of indigenous cover was analysed to ascertain the movement of the forest cover and thereafter sampling points would be chosen based on available data. Both methods served as the initial point of developing a sampling strategy. However, the latter was chosen as it rendered the easiest option with access to available data and reflected the most recent movement of the mature forest cover. The researcher and WCT analysed the profile, extent and structure of the mature riverine forest within the Isimagiliso Wetland Park. Aspects of tree crown cover, height, species, proximity of trees to one another and tree diameter growth were analysed. The sampling of the mature forest profile was a once-off exercise where a ‘control’ figure for the number of trees per hectare was calculated using the mature forest profile. The trees with a diameter of above 10cm DBH were counted in each sampling plot and the average of the number of trees per sampling plot was then taken to be the ‘control’ figure of trees. This was done to facilitate the replication of the riverine forest on the opposite river bank in the KwaJobe Community area. The Mkuze River Floodplain Carbon Sink project model work was thereafter based on the analysed mature forest profile.

#### **3.5.2.2 Deforested Areas in KwaJobe Community**

The original distribution of deforested forest patches and the boundary of the floodplain area in the KwaJobe community were mapped. This exercise was undertaken to assess all baseline conditions before establishing the reforestation

project to create a baseline of environmental conditions of the sites to assess change at a later stage of the project. During this exercise all on-site conditions were surveyed. The area was mapped to reflect an accurate account of the initial and current vegetation conditions and the aerial extent of land being committed to the project by landowners.

The researcher, field workers from the WCT and community landowners undertook a transect walk and mapping exercise along the boundaries of the land that the landowners designated to the reforestation project. The first strategy taken by the community members and landowners was to plant trees along the boundaries. The researcher used a GIS to map the transect walk and planted area to create a 'live' layer of the areas involved in the project. As trust increased within the community regarding the reforestation project model, more parcels of land were given over to the project. These areas were mapped with a GPS and digital layers were added to the original GIS shapefiles. This on-going mapping exercise became a part of the project cycle subject to the availability of land by landowners.

### **3.5.3 Sampling**

The sampling methodologies were designed and implemented by the researcher on behalf of the WCT; however the data is reflected in this study with the permission of the WCT. Carbon sink reforestation initiatives were a new concept introduced to the project activities within the WCT. The WCT was therefore in the initial process of establishing their carbon accounting methods and their implementation methodologies and procedures with the assistance of experts in this specific field of work. Cost effective sampling techniques were investigated, which included the selection of carbon pools. It is important to consider the rate of change of a pool, which methods should be used and will be beneficial to the project from a cost benefit point of view. This is supported by Brown *et al* (2004:5), where it is stated that, "All pools that are expected to decrease as a result of activities must be measured and monitored. Pools that are expected to increase by a small amount, relative to the overall rate of change, need not be measured and monitored". The sampling technique involved an initial soil survey, above ground biomass and the trees on site.

### 3.5.3.1 Sample plots

Each project site was surveyed using a ‘plot’ method derived by Brown *et al* (2004). A Distance Measuring Unit/Equipment (DME) was placed at the centre of the site and determined the range of the plot in 4 meter radius to accommodate the sampling of the trees and vegetation (Plate four). At the centre point of each site two soil samples and an ABG vegetation sample were also taken, where the ABG refers to the herbaceous ground cover such as shrubs.

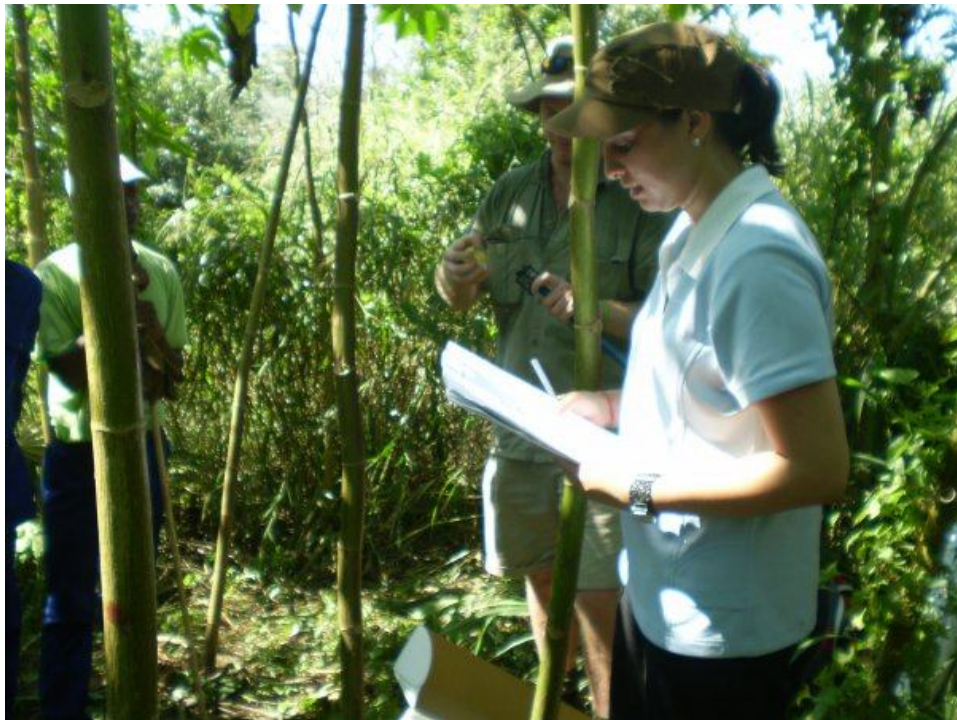


Plate 4: Preparing the DME and data sheets for the sampling plot measurements in the middle of the sampling plot.

### 3.5.3.2 Vegetation

The ABG and tree cover of the planting sites was surveyed using Winrock International’s methods for measuring and monitoring carbon stocks in forests (cited in Brown *et al*, 2004). At each site, at least one ABG vegetation sample was taken (Appendix one) and analysed for moisture content, which was then used to calculate the dry weight and carbon values. All the trees that were in the range of the sampling plot were measured and recorded on data record sheets (Plates five and six).

Tree equations for use in the calculation stage were dependent on (i) the availability of species-specific equations and (ii) the availability of diameter versus wood density figures for all tree species. Where wood density was unavailable for species included in the study, tree diameter was used<sup>1</sup>. The allometric equations stated below provided the best statistical fit for carbon stock measurements hence, the tree species were divided into combined *Acacia* and combined broadleaved categories.

***Combined Acacia*  $\{ \ln(M*10000)=1.0432\ln(D2H)-5.6181 \}$**

***Combined Broadleaved*  $\{ \ln(M*10000)=0.9441\ln(D2H)-4.2786 \}$**

(Netshiluvhi and Scholes, 2001)

For South African tree species specific equations are not available, Brown's (1997) equation for mixed species of tropical trees in dry conditions was used:

***B = exp [-1.996 + 2.32 ln D], where D = dbh*** (Brown 1997)

H = height in meters (m)

D / dbh = diameter above breast height measurement in meters (cm)

M = biomass in kilograms (kg)

It must be noted that the above equation is a suggested equation in the CDM AR-AMS0001 and can be used in the absence of tree species specific equations.

ABG vegetation: dependent on (i) land cover type and (ii) area

tC/ha = Total dry weight / 200

(Where 200 is a conversion factor from grams of carbon to tons, 50% carbon in vegetation is taken into consideration)

1) Summation tC/ha (land cover type) / total no of sites planted = mean tC/ha

2) tC/ha per land cover type = Mean tC/ha \* number of hectares (land cover type)

(MacDicken, 1997)

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<sup>1</sup> Wood density affects the compactness of carbon present in a tree; therefore this parameter can only be used if the wood density exists for all tree species in the study site



Plate 5: Measuring Canopy Height of mature forest using a clinometer, for mature forest carbon baseline calculations.



Plate 6: Working with local project participants filling in the data collection sheets for tree measurements: DBH, canopy height and tree height.

### 3.5.3.3 Soil

Soil sampling was undertaken using a soil auger and carried out to establish the initial baseline carbon stocks, thus allowing one establish changes in carbon stocks over the course of the reforestation project.

Due to the growing interest in the project, more community members joined the project and as a result the project boundary increased. As the project boundary increased and the first samples were analysed, it was concerning that cost outweighed the project budgets. This then made it difficult to undertake micro sampling in each of the carbon pool categories. It was noted that the dry carbon values yielded by the ABG vegetation on-site were too low to make any significant contribution to the overall carbon stock change. As a consequence, the sampling strategy was revised where two soil samples and one ABG vegetation sample was taken, whilst all the trees (woody biomass) were measured. The soil samples taken were analysed for soil texture and Carbon, Nitrogen and Sulphur (CNS) content (Appendices two and three).

Soil:  $tC/ha = \text{Bulk density (g.cm}^{-3}) \times \% \text{ carbon} \times 100 \times 30 \text{ cm}$

100 being a conversion factor related to area (over one hectare of land, AREA (cube) = Length x Breadth x Height)

30 cm = soil sample depth

### 3.5.4 Planting and Carbon calculations

The WCT's existing ITFL project is linked to the Mkuze reforestation efforts and supplies the trees for the planting. With a ready supply of trees available within the KwaJobe community, establishing a reforestation project along the Mkuze River Floodplain became a viable option. As boundaries/ parcels of land were set aside for the project, the area was mapped. The 'control' area of trees was weighed against the area available and the calculated number of trees to be planted was provided to the landowner. Watering of the trees was the responsibility of the landowners. Mature trees were chosen for the planting exercise, to increase rates of survival. Planting the correct number of trees, with a spacing suitable for the mature tree size, affected the die-off and survival rates. During the initial phases of the project, the correct number of trees versus the area of the site was determined through pilot plantings as no known methodology existed for this type of initiative in South Africa.

Information of the seedlings/saplings to be planted was recorded on field data sheets and later entered into an electronic database. This included tree species, numbers, height and diameter above breast height (DBH). A database was established for the purposes of archiving the information collected and using the information to perform the carbon stock accounting calculations using Brown *et al* (1997) Netshiluvhi and Scholes (2001), MacDicken (1997) and the CDM AR-AMS0001. Within the selected carbon pools, that is, trees; vegetation and soil - already developed allometric equations were selected according to best statistical fit for each tree species in the selected study sites. Where national or species-specific equations were unable to satisfy calculation criteria during the initial phases of the project, generic equations developed by the IPCC and the CDM was considered.

Whilst the field work included an element of stakeholder engagement, it was still not adequate in terms of ensuring project sustainability. This was due to the fact that, project participants did not reflect a comprehensive understanding of the objective of this reforestation initiative. This was revealed in the community workshops held prior to implementation of the reforestation initiative, hence, the need for a perceptions analysis of all project participants. Due to South Africa's correlation between land tenure and forest cover, the participation of rural and peri-urban communities is essential for success in any reforestation initiative or REDD+ initiative going forward in South Africa. This is strongly supported by Rahlao *et al* (2012:30) where it is stated that "Firstly, the stakeholders will have to be identified and secondly, mechanisms to engage with them developed". Chapter Four details the methodology used to investigate the perceptions of the KwaJobe community members that participate in the reforestation initiative.

Through the community workshop phases of the project life cycle, various long term partnerships were formed. This effective manner of personal engagement with the community proved to be a success as trust and comfort was built at the outset of the project process. Including the community in the project design phases of the project life cycle created a comfortable atmosphere for the development and steady progress of the project initiative.

The willingness of the Kwajobe community to participate in such a project activity increased over time, and to date has supported the planting of over 122 000 trees back onto the floodplain by hundreds of community members (Wildlands Conservation Trust, 2011). Chapter Four reveals the research design and methods undertaken to analyse the knowledge and perceptions of communities regarding climate change and carbon trading; and investigate the operational potential of carbon sink projects through a critical realist interview process.

## CHAPTER FOUR

### Methods

This chapter provides the research design and the justification thereof, and focuses on the data collection methods, limitations and credibility of the research and data analysis. The research was undertaken in a phased approach, consisting of two phases and two study groups, namely, industry experts working in the environmental arena and community participants from the Kwajobe community. The first phase entailed interviews with industry experts whilst, the second phase involved a participatory interview process with community participants. Industry experts were interviewed to analyse the knowledge of implementing agents, and community participants were interviewed to determine their perception and understanding of the project activity. This aided in identifying and revealing the gaps in project implementation. Both a quantitative and qualitative explanatory design was carried out and used in the data analysis.

#### 4.1 Introduction

According to Carlsson (2005:2), “Critical realism’s manifesto is to recognize the reality of the natural order and the events and discourses of the social world. It holds that one will only be able to understand and change the social world if we identify the structures at work that generate those events”. The idea was to explore the world in a less predetermined way, and allow for the participants to formulate their own views, ideas and routes to which their understandings and experiences were reflected. The research was undertaken through using a critical realist approach to investigate the perceptions, ‘real life’ experiences, and ultimately how these experiences had a ‘cause and effect’ relationship with the operational potential for the carbon sequestration project. This being said, a thematic analysis of data along with aspects of phenomenology were explored as chosen frameworks for data analysis. The proposed questionnaire did not constrain the participants to being inclined to a certain mode of thought. This is shown by the open-ended nature of the questions posed to all participants, allowing the participants to voice their feelings, experiences, understanding and their own interpretation of the research subject matter (Appendix Four). This questionnaire design further supported a critical realist approach. In most cases, verbatim responses and phrases used by both industry experts and community participants’ were used to evaluate and explain the data.

Phenomenological approaches include a range of analyzing techniques and interpretations that are concerned with people's subjective experience. This type of approach makes an epistemological 'leap-of-faith' as it assumes that you can, and should, make inferences regarding people's experiences on the basis of what they say. However, inferences are cautious as the aim is essentially a third-person perspective (i.e. your view of someone else's experience - you can never 'capture' their exact experience). An 'insider's perspective' on the participants' world is reconstructed by the researcher and moves into a wider interpretative realm to take account of the context in which the research is performed (Embree, 2002 and Anonymous, undated, Par 19). Bhaskar (1978 cited in Carlsson 2005:3) outlines three domains in the world; the real, the actual, and the empirical. He goes on to mention that the empirical consists of what we experience; hence the exploration of experienced events best represents the approach taken in this study. Taking into account that one cannot fully and truthfully capture a person's exact experience, it was concluded that a critical realist approach would best describe the results of the data through a thematic analysis.

#### **4.2 Research Design**

A thematic analysis was chosen as the best representative method of analysis. The reason for choosing this method is because it ensures that the participants' perspective comes through in the analysis of the data gathered (Aspers, 2009). In qualitative research it must be acknowledged that participants are influenced by the process and the circumstances before and during the interview. It is important to note that a qualitative approach is a more personal process to embark on as the researcher will bring their own experiences and expertise when attempting to analyse the data. Due to the sensitive nature and newness of the subject matter, it was thought that the most appropriate method of analysis for this research was that of a qualitative approach, and where a quantitative measure was necessary a percentage of responses was used and reflected in the research. Dawson (2010) emphasizes that it is possible to undertake the mechanical process using computing software which can take up much time, although it may stop one becoming familiar with the data. It was therefore decided that a semi-structured interviewing technique will be used, as this reflected

the best manner in which 'real life' experiences could be captured without restricting responses.

A semi-structured interview, informal interview, and opportunistic discussion as part of observation were used in the interview process. This allows participants to relay their experiences the way they see fit and provides a more expressive and truthful account of their related experience. Therefore the content needed to be treated with sensitivity and the researcher focused on a thematic analysis approach.

Two separate questionnaires were designed. The first was for industry experts (Appendices Five to Seven) and the second for community participants (Appendix Four). The nature of responses consists of single words, phrases and/or full sentences. This constitutes narrative data and the focus of the research is to interpret this narrative data in such a way as to provide the best representation of the views expressed by the participants. This was undertaken by reviewing the data, becoming familiar with the content received and acquiring patterns, trends and fluidity with themes deduced by the researcher. Powell and Renner (2003) note that qualitative data consists of words and observations, not numbers; in this case interpretation requires creativity, discipline and systematic approaches. Notwithstanding the fact that language has a role to play in this regard, and is further highlighted by Schütz (1982 cited in Asper, 2004), as it is suggested that language is seen as the medium of both objective and subjective meaning; that is to say, language is the prime vehicle for subjects expressing their mental attitudes. Therefore it is through these words and observations that a more descriptive account of participants' daily experiences can be analysed.

At the same time, however, it imposes a restriction, since language is socially, not individually, constituted. In this way, mental life is to some extent objectively structured by language. Hence the descriptions of our daily experiences differ slightly according to the manner in which it is perceived and translated. It must be noted that participants spoke a different language (isiZulu) to the researcher (English), and therefore a research assistant who spoke both fluent English and IsiZulu was employed to conduct the second phase of the research. The research assistant was

briefed prior to the interviews and provided with all the necessary research materials, and debriefed after the interview sessions.

#### **4.2.1 Ethics**

It was made clear by the KwaJobe community that the researcher would need to carry out her research at her own risk. Face to face discussions between the researcher and the participants took place from the beginning of the research process and it was made clear to all participants that there were no hidden agendas on the part of the researcher. To ensure autonomy was attained at all times during the study informed consent was received in writing and verbally from all the participants. A letter of informed consent was issued to the participants in the first phase of the research (Appendix Eight). Anonymity was ensured and the names of the participants were not used in data description or analysis. Participants' views, perceptions and experiences were interrogated with the aim of representing the most accurate account of the results. However it must be noted that one cannot truly and fully reconstruct another person's reality.

#### **Anonymity**

It was decided that the names of participants and participating organizations would not be revealed due to a lack of consensus regarding these details, with the exception of the Wildlands Conservation Trust. However, it can be mentioned that participants are involved in the following sectors: conservation, commerce, government, environmental management, and carbon economics. The participating countries that featured in this research were South Africa, Zambia and United States. It must be noted, that the mention of a country's participation in the research is in direct reference to the residency of the industry expert at the time the questionnaire was administered.

#### **4.2.2 Qualitative Case Study Approach**

A case study approach was chosen for this research as it allows for a detailed overview of the subject material. As pointed out by Soy (1997) case study research excels at bringing us to an understanding of a complex issue, emphasize contextual analysis of events and their relationships. The following method was used during this case study approach as proposed by Soy (1997: par 5):

1. determine and define the research question,
2. select the case and determine the data gathering and analysis techniques,
3. prepare to collect the data,
4. collection of the data in the field,
5. evaluate and analyse the data, and
6. prepare the findings.

The case study of the Mkuze River Floodplain Carbon Sink project was undertaken to evaluate the perspectives of the project through the experiences of the project participants. This is supported by Stake (2003) and Yin (2003) (cited in Baxter and Jack 2008: 545) who base their case study approaches on a constructivist paradigm as follows, “This paradigm recognizes the importance of the subjective human creation of meaning, but doesn’t reject outright some notion of objectivity”. This approach allowed the researcher to evaluate the operational characteristics of the reforestation effort answering the ‘how’ and ‘why’ questions whilst taking into account the context of the project.

### **4.3 Sampling and Data Collection**

#### **4.3.1 Primary Data Collection**

The data collection process was conducted in a two-phased approach. Phase one included interviews with industry experts, whilst phase two included interviews with the Kwajobe community project participants. Data was collected using a semi-structured interviewing technique in conjunction with questionnaires.

**4.3.1.1 Phase One:** Industry experts chosen for this phase of the research are involved in the field of climate change, ecology, environmental management, biodiversity conservation and carbon sequestration. A purposive sampling strategy was used to select a small pool of 10 participants. This approach was chosen as the researcher had a specific purpose in mind along with a specific category of people required. With a purposive sample, you are likely to obtain the opinions of your target population, and this was the desired outcome (Trochim, 2006). This phase of the research involved electronic questionnaires with professional experts. Due to the logistical challenges,

personal interviews were not possible therefore questionnaires were administered using electronic mail. A total of 10 questionnaires were administered, and seven were completed. The interviewees came from various environmental backgrounds which included conservation, restoration, ecology and climate change.

#### **4.3.1.1.1 Industry expert Questionnaires**

A structured questionnaire comprising three sections, was used in this phase of the research. Industry experts were contacted telephonically and received the questionnaires via electronic mail. The participant answered the first section of the questionnaire, thereafter followed a decision probability matrix that then led him/ her to either section two or three of the questionnaire that they needed to answer. For the structured part of the process, no translation was required.

The electronic questionnaires allowed both international and national participants to participate in the research. A total of 15 questionnaires were sent out to professionals in the Climate change and Environmental Management fields for participation, along with ethical clearance forms and a guideline on how to answer the questionnaire (Appendix Four)

#### **4.3.1.1.2 The Probability Matrix**

This phase of the research process was designed in a three sectioned approach to allow participants to participate in this research irrespective of their levels of knowledge (Appendices Six and Seven). The first section of the questionnaire focused on two general concepts, the understanding of the concepts carbon sequestration and carbon sink. Upon answering the general concept questions, the participant entered his/her responses into a probability matrix that then guided the participant to the correct subsequent section of the questionnaire, that is, section two or section three. The probability matrix was designed to assist the participant in following the correct path when answering the questionnaire (Table 4.1)

Table 4.1 The probability matrix.

	Question 1	Question 2	Respondent answer to
Answers	YES	YES	Section 2
	NO	YES	Section 2
	YES	NO	Section 3
	NO	NO	Section 3

#### 4.3.1.2 Phase Two

The second phase of the data collection process involved interviews with the local community members that participated in The Mkuze River Floodplain Carbon sink project. The participants ranged from tribal leaders, ward councilors, housewives, working class adults and young adults who were unemployed. Due to logistical difficulties and a language barrier, a research assistant was employed to administer the questionnaires. A total of 100 questionnaires were administered to project participants, of which, 85 responses were received. The remaining questionnaires were not answered as not all project participants were available to participate in the research exercise.

##### 4.3.1.2.1 Questionnaire

For the second phase of the research, a semi-structured interviewing technique was used in conjunction with a questionnaire. Interviewees were asked open-ended questions in sequence as per the structure of the questionnaire, whilst allowing them the freedom to express their answers in the manner they saw fit. Translation was required for this part of the research and carried out by the research assistant.

##### 4.3.1.3 The Community study group

The sample population consisting of project participants only, of Phase Two of the research comes from the KwaJobe community area. The population consists of adults between the ages of 20 – 70, showing a wide range of participation in the current research, amongst community members. All participants spoke fluent Isizulu, most could not speak English, therefore translation was used. A few other community members could not read or write, therefore the community member verbally answered questions whilst the research assistant wrote the responses down. A working relationship had been established between one of the ward councilors, and the

researcher. As a result, the community interviews were easily organized. The information received through the community survey results assisted in guiding the formation of the 'How to Guide'.

### **4.3.2 Secondary Data Collection**

Information was obtained from academic books, journal articles, media in the form of newspapers and internet sources. This information was used to create a foundation and theoretical framework for the research.

## **4.4 Data Analysis**

### **4.4.1 Thematic Analysis**

**4.4.1.1 Phase one:** Most methods of data interpretation for qualitative analysis involve the researcher reading through the data, annotating and identifying particular objects of interest (Embree, 2002 and Anonymous, undated, Par 1). Charmaz (1995 cited in de Bruin, 2006:16) points out that, "The first major analytic phase of the research consists of coding the data. In short, coding is the process of defining what the data are all about. Unlike quantitative coding, which means applying preconceived codes (all planned before the researcher even collects data) to the data, qualitative coding means creating the codes as you study your data". In this research the researcher reviewed the data, organised the data into categories based on identified themes, and analysed the data to draw interpretation and inferences. Cited in Cook *et al* (2010), Kitchin and Tate (2000) have argued, qualitative research accesses the very core of a situation or problem. This research is qualitative in nature and involved an interactive approach during the interview process as questionnaires were designed as open-ended in most cases, thereby allowing participants to engage with the research on a more personal level. This is highlighted in the information presented below (Embree, 2002), as it is clearly stated that the research process is both more creative, and more interactive, at all stages, for qualitative researchers. As codes are accumulated, the researcher will begin to sort the data into themes. This represents a shift from the particular (line-by-line codes) to the general (patterns within those codes). More often than not, however, interview data was collected to explore participants' 'frameworks of meaning.' It therefore makes sense to apply a more

open-ended approach. Typically, this means that qualitative reports include excerpts of raw data, in the form of extended quotations, alongside the researchers' accounts. This allows the reader to perform a validity check between the data and the researchers account (Embree 2002).

Although the coding method of analysing the data has not been explicitly used, elements of it were coupled with a thematic analysis and together provide an open-ended and transparent base in which interpretation of the data occurs. “If we are to understand the social world and meet the demands of phenomenology, we must produce explanations that are grounded in the subjective experiences of real people” (Asper, 2004:5). Adding to Asper (2004), it must be stated that a reflection of daily ‘real life’ experiences were hoped to be captured during this research, as close to reality as possible. This was achieved through the critical realist approach, revealing the daily interaction the participants had with the Mkuze River Floodplain Carbon Sink project. This is further supported by Jeppesen (2005:4), as he states that a central point of the Critical Realist ontology is the division of reality into different domains with specific propensities. At the domain of the empirical we can make observations of ‘experiences’, meaning the visible observations of the phenomena, we study. The researcher gathered information based on perceptions, and represented the views of the participants in the first order construction of the participants view. This was undertaken to avoid distorting any of the information in the process. In this manner the ‘cause and effect’ operational relationship the participants have with such projects would be more realistic and revealing. In addressing the objectives of the research it must be enforced that, “The main point of this approach is to ensure that the subjective perspective comes through; that no scientific explanation exists unless what is studied is related to the first-order constructs of those studied. Having said this, not all of the steps and techniques discussed are unique to empirical phenomenology, and it is of course possible to make use of parts of this approach while leaving others out” (Asper, 2004:11).

According to Hawe *et al* (1990), there are four steps to analysing data, organise, shape, interpret and explain. Following this definition, the research followed this manner for all data analysis. The data analysis conducted in Microsoft Excel follows a thematic analysis theme and provides quantitative estimates. Data was organised,

typed out into broad concept categories, then sorted and shaped into information by assessing which themes emerged. The process involved a further interpretative step whereby relationships between categories and themes were deduced and explained.

#### **4.4.2 Spreadsheet Analysis**

During Phase Two each participant's response was entered into a spreadsheet that attributed to whether they understood the concept or not. It was decided that if the participant understood the concept this deduction will yield a 'yes' response, and was given a value of one. If the person did not understand the concept a response of 'no' was written down and was given a value of zero. After all the responses were entered, a formula was devised to count the number of responses that yielded either one as their response or a zero as the final response.

This formula reads as follows: =COUNTIF (range, criteria), where range is the range of cells from which one wants to count cells. For the purposes of this research, the range was the number of responses received for an issue. The criteria define which cells will be counted or in what fashion they are counted. The criteria were the assigned score given as either one, or zero. Both of which counted the number of responses for that specific issue that yielded a score of one or zero as derived from participants responses.

Clustered column graphs were created to represent the proportion of responses that demonstrated which issues featured as 'understood' against those issues that featured as 'not understood'. Direct and unchanged responses from participants were reflected in the results chapter of the thesis.

#### **4.5 Limitations of the research**

Logistical challenges were experienced. The study site located in the Kwajobe area is approximately 800 kilometers north of Durban, KwaZulu-Natal. As a result it took a great amount of logistical planning to interview the community members. The local language at the study site is IsiZulu and translation was used during the second phase of the research. The possibility exists that the messages and responses received from community members are distorted due to the language barrier. This was overcome to a degree by discussing each questionnaire at length with the research assistant. It is

important to acknowledge that there is a possibility data collectors and translators might have provided the researcher with the knowledge that was sought. Carbon sequestration reforestation projects are a recent global development, therefore one of the major limitations to the research was the lack of country-specific literature in relation to local community dynamics and stakeholder participation. It must also be mentioned that the data collected from the field work processes in the Mkuze River Floodplain Carbon Sink project is the intellectual property of the WCT.

In the following chapter, a detailed description of the data, the results generated and the direct responses received are presented. To illustrate the reasons participants provided for their choices during the interviewing process, a selection of responses received from the participants are quoted in italics.

## CHAPTER FIVE

### Results

#### 5.1 Results

This chapter presents the results from both Phase One and Phase Two and is subdivided into several broad themes. Responses gathered from participant interviews were used to formulate the results for analysis and supplement the research discussion. The research analysis follows a thematic analysis approach, which enabled the researcher to derive broad themes which supported interpretative perception analysis of participants' responses.

##### 5.1.1 Phase One and Phase Two Results

The results are presented using clustered column graphs that represent percentages of responses that attributed to whether the participant did or did not understand the concept. Each representation is explained using the unchanged responses received. The x-axis represents the questions, and the y-axis represents the number of responses expressed as a percentage. Data are converted to percentages of the total number of questionnaires, discussed and presented below in conjunction with the derived themes.

The first section of the industry experts' questionnaire guided the participant on how to answer the various sections of the questionnaire, and was supplemented with examples (Appendix Five). Thereafter the industry expert participant was guided to the relevant second section questionnaire. The community participants' questionnaire was semi-structured allowing participants to express their subject experiences.

##### 5.1.1.1 Broad Themes: Industry Experts

The themes presented are derived from responses by industry expert participants and responses revealing similar characteristics in each question were grouped. It was found that the derived themes linked to the literature presented in Chapter Two.

The concept questions were designed to ascertain if the participant was familiar with the concepts carbon sequestration and carbon sink. Most industry expert participants understood the concepts. The general understanding of the term sequestration was the

ability of terrestrial and marine ecosystems to absorb carbon from the atmosphere. One response detailed that *'sequestration is the idea of working out how much carbon a tree absorbs over its life time, usually a twenty year period is used as good measure'*. The concept of a carbon sink was understood as a specific reservoir / system of storage, such as a forest or the ocean which takes up more carbon than it releases. The following broad themes were derived for the concept questions (Figure 5.1).

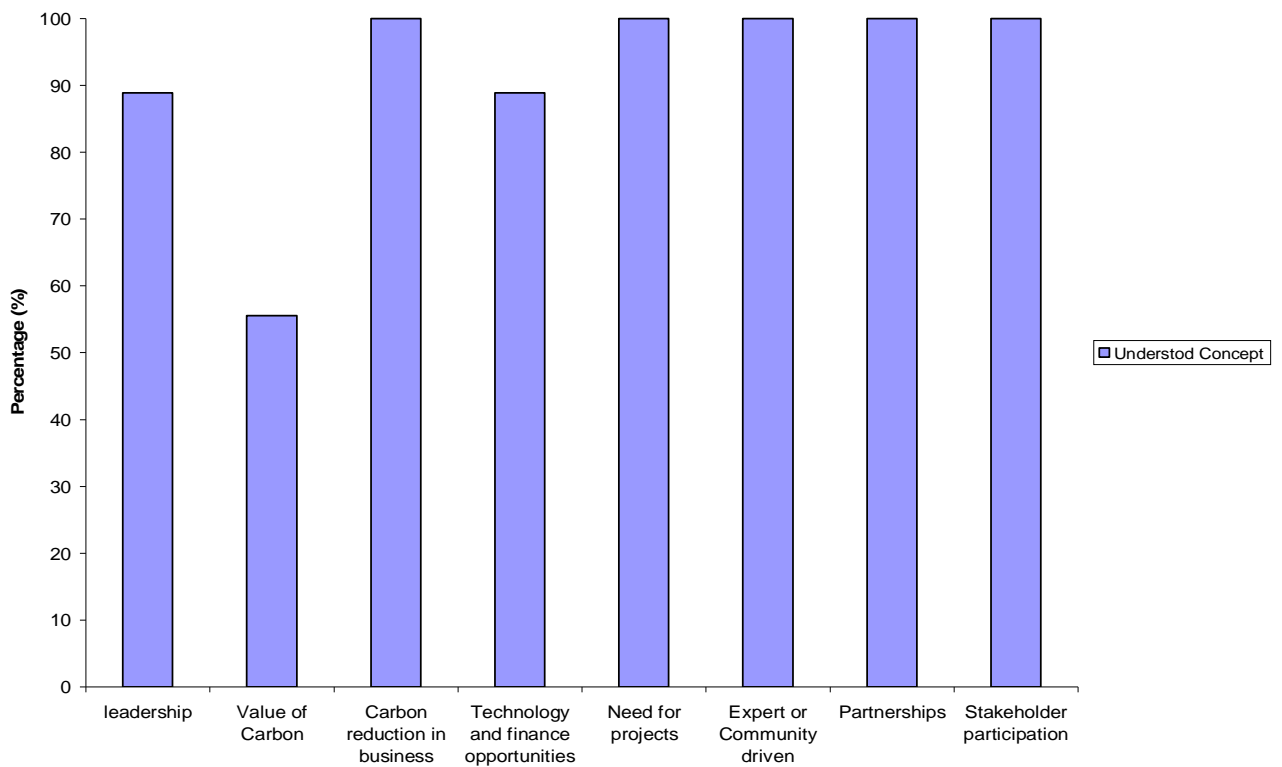


Figure 5.1: Derived themes.

### **5.1.1.2. Financial Costs and Funding**

The responses to the financial section of the questionnaire illustrated understanding by participants showing a figure of ninety percent (figure 5.1). The questions related to whether the participant was aware of any funding opportunities for such projects and whom they would approach to access such opportunities. A general concern was that the lack of finance was a major limitation in project activities. This included start-up finance, medium to long term finance and finally a revenue generating stage where the project will sustain itself. The most prevalent response alluded to the requirement of initial or upfront project costs and the fact that industry and business needing to actively participate in such projects. One response received stated a *'need for upfront costs for implementation'*, further emphasizing the need for start-up finance.

According to the responses received, the organizations, companies and industries to be approached for funding are: Governments and Non-governmental Organisations, automotive dealers, mining groups, Carbon partnership facility, private and corporate business, Philanthropy, and the United Nations (UN). The lack of funding opportunities and financial incentives from government was a collective response, for *'funding forest carbon projects is often more difficult than other carbon trading projects so one may need to contact multiple funders'*.

### **5.1.1.3 Roles and Responsibilities**

All responses dealing with leadership and responsibilities present three concepts: Government should provide an advisory and finance mobilizing role; experts should provide the technological 'know how'; and upon being skilled, the participating communities should take ownership of the projects. The majority of industry experts recognized the fact that without the full cooperation and participation of local communities, it is unlikely to succeed. This is related to the responses received from community participants in phase two, in which all participants state that they will not participate in any project activity if they do not have all the information they require or, do not trust the implementing organization. This was illustrated by responses received revealing the need for collaboration between experts and local communities in the project process. For example, *'there is currently a need for experts to guide communities on such projects and to raise awareness'*, *'a community will not have the technical capacity to run a sequestration project'*.

The concept of leadership and expert versus community-driven projects was asked. Eighty-eight percent of the participants responded that it is a mix between the local participating community and the experts who possessed the technical expertise. Another interesting response mentioned that one will require good ‘community organising’, this is in line with the fact that good communication and planning skills are required to operationalise any project, especially one as complex as a carbon sequestration reforestation project. One of the main points from the responses received is that of communicating information to younger generations, to heighten awareness and allow for future generations to become leaders in this arena.

#### **5.1.1.4 Technological complexities**

A general lack of skills and holistic approaches to such initiatives was the broad response received. However, surprisingly a number of responses indicated that the environmental organization they were employed at did not possess adequate technical skills capacity, such as knowledge of carbon sampling methodologies and carbon stock change calculations to establish reforestation projects. Some responses revealed that the South African industry involved in such project / academically-related activities lacked a community organization background. It was also mentioned that the prediction, measurement, management and implementation of such carbon initiatives require specific skills that are needed at different levels of the project phases. The industry experts suggested that South Africa’s technical capacity to implement and manage such projects was of an insufficient standard.

Most organisations complained of a lack of finance for the initial phases of these projects, or a limit to donor funding for project implementation. Others made mention of the fact that the organisation may not directly be an implementing agent but instead conduct specific areas of research that filter into the project cycle. An interesting set of responses focused on the financial issues rather than the technical capacity issues. Selected responses include, *‘We can roll out many more projects if funds become available’*, *‘as people become more aware, there is a huge opportunity to link investment into landscape management’* and *‘main focus is to introduce carbon farming as a new landuse’*.

The need for technical experts and community development skills was highlighted in the participants' responses.

#### **5.1.1.5 Policy and Political Dynamics**

Many responses pointed to the fact that both globally and locally there is a lack of political will to delve into these types of initiatives, as there is a considerable lack of carbon sink project activities endorsed and implemented on national scales. The following policies, agreements and guidelines were mentioned by participants: UNFCCC, REDD+, CDM, VCS, Kyoto Protocol, Joint Implementation, CCBS. This was supported by the fact that participants feel that South Africa in particular lacks a competitive advantage against other developing countries such as Tanzania and the Democratic Republic of Congo that are beginning to define what role these projects play for the country and the people.

Another point made was that more public awareness campaigns related to climate change and its effects and impacts need to be devised and implemented country wide, especially in areas where reforestation projects are a possibility. A few responses pertaining to more detailed knowledge were received stating that *'very little in local/national policy but hope the national climate change response strategy will address this'*.

#### **5.1.1.6 Specificity to Country**

Many responses called for carbon sequestration projects and including those that are a possibility for the near future such as, REDD+; to take into account a country's specific needs and national circumstances. This was supported by the Marrakesh Accords (2001:9) as it is noted in the Accords that, "there is no 'one size fits all' formula for capacity-building. The implementation of these projects will be more successful if elements such as capacity-building are country-driven, addressing the specific needs and conditions of developing countries and reflecting their national sustainable development strategies, priorities and initiatives. It is primarily to be undertaken by and in developing countries in accordance with the provisions of the Convention". This is shown by the responses received by industry participants that demand these types of projects show real benefit sharing in the participating

communities, without compromising the rights of indigenous people and forest dependent communities.

The need for such projects, partnerships, stakeholder participation and project implementation was explored. Responses included the fact that there are two main co-benefits to such projects, one being the socio-economic aspects and the other the restoration and conservation of natural landscapes. Responses include, *'well designed and implemented projects offer the opportunity for additional benefits such as biodiversity conservation, jobs, food security and poverty reduction'* The most frequent response received in relation to the issue 'specificity to country', covered issues of knowledge and skills, diversity in implementation, and risk aversion. Highlighted was the fact that even if the carbon aspect of the project fails, other aspects might still progress with a collaborative partnerships in place. Participants also mentioned, *'the design and then implementation of the project will require different skills and knowledge and expertise'*.

Participants felt that all major sectors of society should participate in such projects at different levels and with different roles and responsibilities. These include; government, non-governmental organisations, communities, academia and research institutions. These were chosen by participants for the following reasons; technical input, legal support, indigenous knowledge and grass-roots understanding, promotion of education and awareness. For example *'I believe that to create awareness the leaders of the country need to buy into the idea and actually lead from the front, if they show the general public that they are serious about reducing emissions then the public will be more likely to join.'*

Participants believed the understanding of roles and responsibilities in the project process are significant to the initial success, while the technical aspects such as ecological, social, GIS and land surveys are a good indicator of the size and extent of project that can be accommodated before implementation, for example

- *'We are not there yet so it is difficult to say'*
- *'must have a strong financial sustainability component'*
- *'meaningful participation, open communication, flexibility in plans, education'*

- *'prior to each project, potential risks, costs and benefits need to be identified'.*

#### **5.1.1.7 Value of Carbon**

The value of carbon and carbon reduction in an organisation's core business proved to be a difficult question to answer, as the responses were varied and not all participants understood this question. Industry expert participants did not believe carbon prices in the market will endure and therefore this will not make a carbon livelihood feasible. While others felt that the value of carbon should be increased and traded more openly on stock exchanges and only projects that meet leakage and permanence issues will benefit.

Five out of the nine industry expert participants mentioned that their organisations are implementing carbon reduction strategies. The responses revealed that participants made an attempt to try and reduce emissions while in other cases they did not, this is shown by the following responses, *'on site carbon mitigation schemes are evident but I am not familiar with the details'*, *'we try to minimise consumption of everything possible'* and *'you don't want to know our carbon footprint!'*

#### **5.2.1 Broad Themes: Community Participants**

The themes below are derived from the responses received during Phase Two. They reflect both positive and negative responses received, so as to ensure that no data was excluded from the interpretation and that a candid account of the data could be undertaken.

##### **5.2.1.1 Climate Change**

A lack of understanding of the concept 'climate change' was revealed (Figure 5.2). An interpretive perception of the concept was evident, illustrated by these participants' responses:

- *'Since the world is hot, too much people and animals, not trees, not a good life because of shortage of water';*
- *'the drought is taking place';*
- *'talk to firms to reduce poison from the environment'*
- *'we need environmental education'*

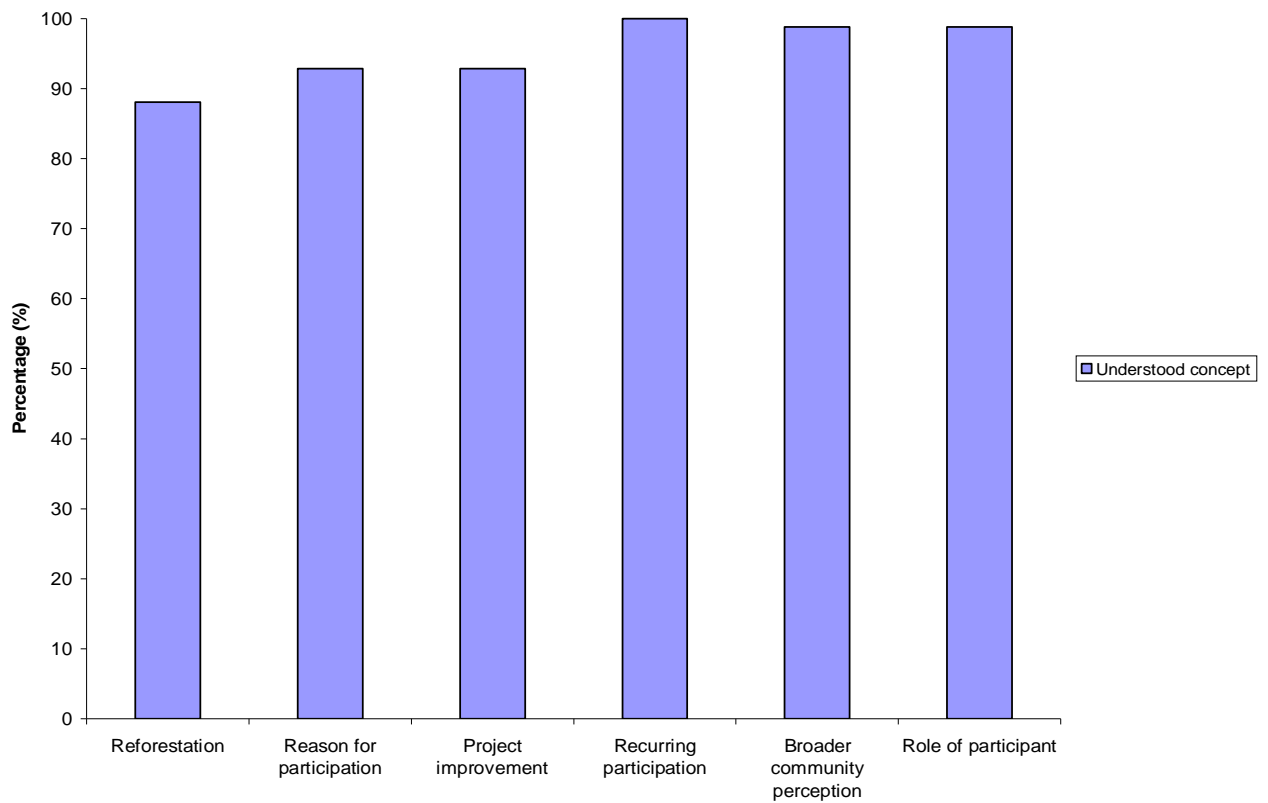


Figure 5.2 Specific Questions.

### 5.2.1.2 Social Upliftment

A sense of belonging, ownership and a reduction of apathy in one's life were described in responses. Ninety-three percent (Figure 5.2) of the participants were able to effectively express their reason for participation while seven percent did not. The overall perception of the project was one of pride; ownership and belonging to something that made participants feel less apathetic to their current circumstance, for example *'I have a calling in planting and has improve the quality of life'*.

### 5.2.2.3 Education Dissemination

Gaining knowledge made the participants feel more confident regarding their abilities and skills both in the project and on a personal level. Environmental education featured as an important aspect of the project process, as expressed by participants. The participants' responses revealed that the project added value to one's education and knowledge base. Ninety-nine percent of participants understood the questions

being asked, and participants were positive regarding participating in this project due to the value it added to their lives, for example *'I feel free and happy about it, it makes me feel special and excited'*; *'I feel proud and I gain knowledge from it'*.

The community's perception of the neighbouring riverine forest revealed that 98 percent of the participants understood the reforestation concept, and were willing to learn and participate in this community project. Responses stated, *'almost all of us joined so therefore we want to keep the forest alive'* and *'they joined the project'*.

#### **5.2.2.4 Sustained Participation**

A sense of faith in the community members was evident and this reduced reluctance to participate in further projects of this nature as responses indicated a willingness to participate again if ever offered the opportunity to do so. The evidence presented shows that participants are trusting of the implementing organization. Participants were steered towards exploring the notion of whether they would venture into other projects such as the Mkuze River Floodplain Carbon Sink project and asked if they would consider participating. All participants were eager to participate in further project ventures of this type provided they have the capacity to do so, *'I can see it will bring progress'*; *'if that other project will be as helpful as this one, definitely, I will join'*.

#### **5.2.2.5 Increased recognition for forest preservation and heightened awareness of surrounding environment**

Forest conservation and environmental preservation is not new to the participants as they reside opposite the Mkuze riverine forest and understand the value of the forest. However, it is clear that the community places much value on the forest, for example, *'if we get old they will still remain the same and our grandchildren see it'* and *'it protect our land in the storm time'*. Other types of value placed on the forest were fuel wood, shelter, medicine, fencing, food, and most surprisingly aesthetic pleasure. The community members appreciated their natural surroundings to the extent where aesthetic value was mentioned.

In relation to recognition of the forest, the concepts of project improvement and sustainability were put to participants. Ninety-two percent understood what was being asked, and an interesting array of responses was received:-

- *'if we can get more sponsors to give us fertilizers so we can plant more trees';*  
*'other companies must donate into the project';*
- *'we can meet like a group to get more knowledge from each other';*
- *'if we can get help from the government';*
- *'I think if we can plant trees in line with the season';*

#### **5.2.2.6 Harvesting of trees**

This specific theme was deemed negative / disadvantageous to the process by the researcher as it does not conform to the basic principles behind the concepts of reforestation and REDD+. Both of the concepts create room for conservation and preservation in the carbon sequestration context. However, from the responses received, it was evident that the proposal of cutting and selling trees was a preferred option amongst some of the project participants as a form of livelihoods. While the intention and objective of the project is to conserve the forest cover, it is seen that some of the project participants' motives differ from the objective of the project. The above findings highlight that the project information conveyed to participants via community workshops is critical to developing an understanding of the goals of the project objectives.

Chapter six provides a detailed account of the research findings in the form of a 'How To' Guide as a product of the research. The 'How to Guide', is a step-by-step derived methodology of the elements required for the establishment of such projects, and was developed from the findings and experiences of the researcher.

## **CHAPTER SIX**

### **‘HOW to GUIDE’**

This chapter provides an overview of the procedures involved in the carbon sequestration reforestation project process. It explores and expands upon the community engagement aspect of the project process to fill the stakeholder participation gap as expressed in chapters one and two, whilst providing an integrative tool to establish such projects. The ‘How To Guide’ developed by the researcher is a result of the combination of the implementation work carried out in the KwaJobe community as part of the WCT work and the research carried out for this thesis. Currently an applied and practical guideline on how to implement such projects does not exist in South Africa. This ‘How To Guide’ provides a detailed approach to designing and implementing community reforestation carbon sink projects; and forms the basis for further research to be carried out in this field.

For one to successfully implement and execute the activities related to such projects, one needs to consider the following:

1. What do you want to achieve from such a project?
2. What information will be needed?
3. What will be the methods of data collection?
4. What information will be collected or surveyed based on information needed?
5. How will this information be analyzed to achieve the necessary objectives?
6. How will this information help the project continuously progress?
7. What are the opportunity costs and risks associated with the project intervention?

All the data and information collected in the project process should have a function and purpose that will add value to the project life cycle. This will aid in fulfilling the overall objectives of such project initiatives, such as:-

- increasing carbon stocks
- enhancing removals of greenhouse gases/ reduction in greenhouse gas emissions

- positively contributing to biodiversity conservation and the livelihoods of the communities involved.

### 6.1 The Step-by-Step Project Procedure

The findings of the current research informed the design of a ‘model for implementation’, as illustrated in a step-by-step flow chart (Figure 6.1) created by the researcher, to assist project managers and implementing agents involved in the project implementation procedure All ten steps are explained below<sup>2</sup>.

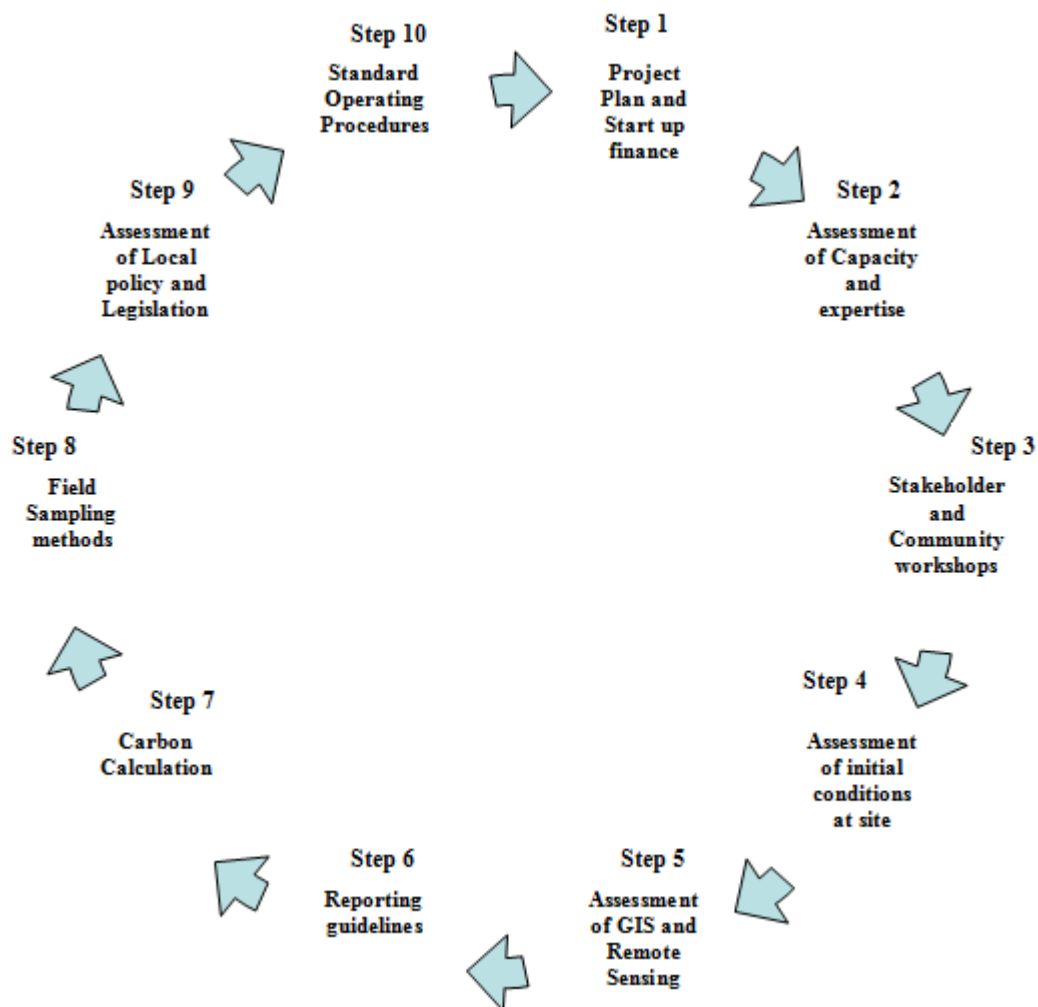


Figure 6.1 Project Implementation Procedure

<sup>2</sup> Due to the fact that this research study has not been carried out before in the South African context, the majority of the information presented in this chapter is assumed and further research is required to improve the scientific integrity of this study.

## **STEP 1**

### **Project Plan and secure start-up finance**

It is important to secure start-up finance for the initial stages of the project process, as most activities will require a ‘trial and error’ basis from which to begin. Start-up finance can be sourced from government funding, bilateral funding with other countries and/or donor funding from the private sector. The time, cost and quality components of the project must be identified at this stage so as to satisfy all stakeholders’ needs in the early phases of the project. Thus, the implementing organization needs to take into account the time lag between activities and revenue-generating carbon credits.

A significant stage of the project process is the planning stage. It is important to recognise the need for a comprehensive project plan at the outset. It is also necessary that the implementing organization presents different scenarios to determine any potential risks such as leakage issues. A GIS or desktop exercise of overlaying different data sets is a possible way to assess feasibility for such projects. The following must be taken into account during the feasibility assessment to outline the possible areas that meet the needs of the project:

1. Aerial photography from more than 50 years prior to the site’s current condition. It is important that areas to be reforested were forest in the past and not of any other land use type. This will impact on the integrity of the project as a change in land use will have differing effects of the carbon stock changes.
2. Water bodies, to assess the range and potential of water availability.
3. Temperature index, to assess temperature trends over a long to medium term period.
4. Land zoning, to assess what are the future land use changes expected for the area.
5. Land tenure or cadastral data, to assess the ownership of the land and the boundaries associated thereof.
6. A map indicating the vicinity of any and all road, rivers, servitudes etc., to assess the amount of land that will eventually be available to a project.
7. Population/ census in conjunction with a residential layer (if any), to assess the population dynamics in relation to the potential project site.

8. Access routes, to determine where the access routes are in relation to the potential project site.
9. Soil data, to assess the landscape on a geological and geomorphological level to determine the most appropriate conditions for tree growth and sustainability.

Noting the immense amount of jargon used, all abbreviations, calculations anticipated, glossary of terms, definitions must be included so as to create a more conducive environment for the user/ implementing organization. A project plan will include a logical framework, activities and inputs and resources required (Tables 6.1, 6.2 and 6.3). This is then supplemented by an internal audit of management capacity (Figure 6.2). The project plan will eventually form an important part of the Standard Operating Procedure documents produced.

Table 6.1 Project Schedule for Carbon Sink Reforestation Project.

<b>Project Schedule for Carbon Sink Reforestation Project: Logical Framework</b> <b>Project team</b>
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Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
<b>GOAL: CO2 Sequestration</b>	(1) Increased number of landowners signing into the project	Project records	
	(2) Increased forest footprint	GIS track record	
	(3) All baseline surveys completed	initial project site conditions identified	
<b>PURPOSE: Reforested land</b>	(1) Number of trees planted	Quarterly check on data entry process	
	(2) Number of locals employed by the project	Quarterly check on data entry process	
	(2) Number of hectares planted at the project site	Quarterly check on data entry process	
<b>OUTPUTS:</b>			
<b>(1) Carbon Stock Figures</b>	(1) Progressive carbon stock figures produced	Quarterly check on data entry process	
	(2) Total area planted is calculated to date	Quarterly check on data entry process	
<b>(2) Project Design Document</b>	(1) PIN completed	Number of pages written	
	(2) Each section of the project elements completed	PDD criteria fulfilled	
<b>(3) Relational Database</b>	(1) Completed tables of data to date	Quarterly check on data entry process	
	(2) completed track record of data	Project records	
	(3) Functional Geo database	Number of feature classes in the GDB	
<b>(4) Standard Operating Procedures</b>	(1) Latest version available to field staff	Track record of completed versions available to date	

Table 6.2 Required Project Inputs.

<b>ACTIVITIES</b>	<b>INPUTS</b>		<b>BUDGET</b>	<b>STATUS</b>
	<b>WHO IS RESPONSIBLE</b>	<b>RESOURCES REQUIRED</b>		
<b>(1) GPS and GIS work</b>		GPS, GIS software, High speed computer		
<b>(2) Field sampling</b>		DME, Soil Corer, Clinometer, Vegetation square, GPS...+ (other required)		
<b>(3) delivery of trees to site</b>		Vehicle, trees, Available list of required delivery		
<b>(4) Liaison with landowners</b>		Background material to the project, Stationery, Transport		
<b>(5) Database entry</b>		Fully functional relational database, All data entry forms, consistent flow of information		
<b>(6) Carbon calculation procedure</b>		Correct allometric equations, GIS layers with area calculated, Species lists, Numbers of species planted, Soil and Veg sample analysis results		
<b>(7) Planting of trees</b>		Trees, Varying species mix, Vehicle, List of landowners requiring delivery, Water, required tools, Landowner at site		

Table 6.3 Expected Project Timeline (filled coloured blocks represent the recommended / estimated time duration per activity).

	Project Timeline											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ACTIVITY												
(1) Project Plan/Start up finance												
(2) Assessment of Capacity/Expertise												
(3) Stakeholder Workshops												
(4) Assessment of initial site conditions												
(5) Assessment of GIS and Remote Sensing												
(6) Reporting Guidelines												
(7) Carbon Calculations												
(8) Field Sampling methods												
(9) Assessment of Policy and Legislation												
(10) Standard Operating Procedures												

## STEP 2

### Assessing internal management capacity and outsourcing of expertise

Informed by the findings of the current research, three evaluation criteria are described namely internal capacity, leveraging potential and outsourcing (Figure 6.2).

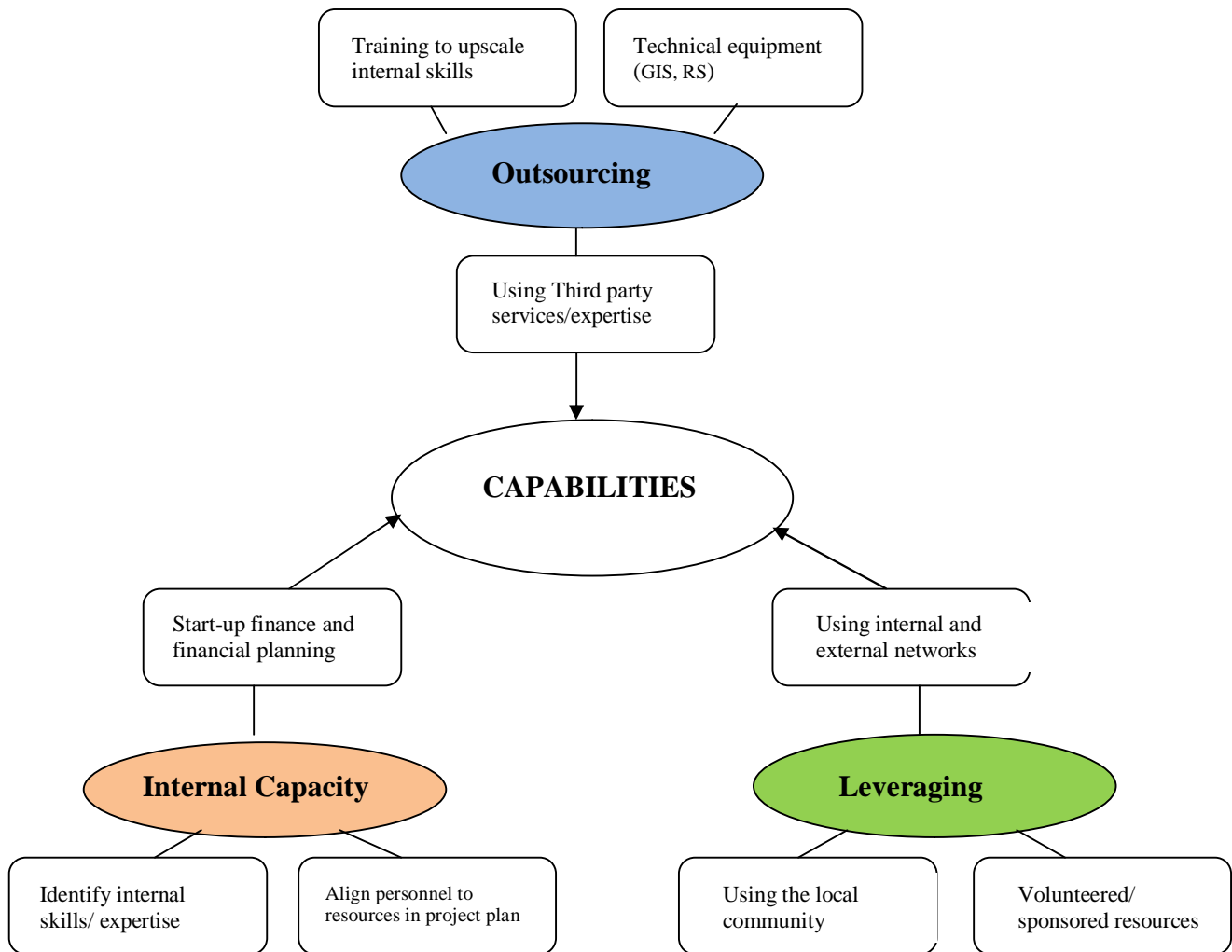


Figure 6.2 Skills and Capacity Evaluation.

Carbon sink reforestation projects require a multi-faceted array of skills and expertise, therefore assessing an organization's capacity, capabilities and potential to leverage is an important step. Tulloch (1990) defines capacity as having the ability, potential and competency to perform a task. Aligning the organisation's personnel to the resources and inputs required in the project plan provides clarity to the real potential the organisation has to carry out the project.

In the event of the organisation not meeting its internal capacity criteria, the organisation needs to investigate its potential to leverage and outsource what is required by the project. Leveraging is defined as a means of accomplishing a purpose as stated by Tullock (1990). It is important for the organisation to evaluate all of the existing internal and external networks it is a part of and use this potential to its benefit. In the case of carbon sink reforestation projects, the local community should be used as a first point of departure so as to enhance capacity building.

The costs of such projects are high and it is important to recognize this up-front and begin the outsourcing process. This will depend on the cost, quality and time element of the project. Heizer and Render (2006) characterize outsourcing as part of a continuing trend that utilizes the efficiency that comes with specialization. If the project requires such an element, it is preferable that this is identified and dealt with in the project plan.

### **STEP 3**

#### **Stakeholder and Community Workshops**

Stakeholder engagement is of prime importance to any project activity that requires the participation of local communities. A significant building block to the success of any project that requires the participation of local communities is the relationship the implementing organization has with the community. The evidence gathered in this research proved that the success of such initiatives rely on good relationships and trust between the implementing organization and the community involved. Stakeholder workshops are important in developing trustworthy relationships that allow for effective implementation.

Conducting stakeholder/ community workshops is one of the first steps that should be taken in the project process. It is important to consider the language and cultural barriers that exist and how it may help or hinder the progress of projects. Climate change concepts and terms are not necessarily translatable; this could have a negative effect on the perceptions and understanding of the subject matter. It is therefore necessary to pilot the workshop with an audience of the same language and all the required subject material. This will aid in reducing any possible misunderstandings and reduce the risks of misinterpretation.

Noting that all communities are different in their socio-economic dynamics and physical background, it is important to host the workshop in a familiar setting to create an atmosphere of ease. It is necessary to present the subject matter using familiar and local examples that the community are able to relate to. This makes it easier for the community to become familiar with and understand complicated subject matter. Visual aids and interactive workshop material proves to be a valuable tool in this regard. The presenter or workshop host(s) should familiarise themselves with the local culture, be patient and respect the audience. This allows the audience to fully and effectively participate in the activities, and a more truthful account of their interpretation and interaction may surface.

#### **STEP 4**

##### **Assessment of initial conditions at site**

Before a project of this nature begins, it is advisable to undertake a thorough field assessment of the biophysical elements, microclimatic conditions and the socio-economic dynamics. This aids in creating a clear picture of the surroundings at the potential project site. It also allows the implementing organization to plan the project in accordance with the nature of the project site. One can do this by assessing the following:-

##### **Biodiversity Assessment**

1. the condition of the soil
2. the vegetation
3. the species composition of all ground herbaceous vegetation and trees
4. the manner in which the tree species (if any) grow and how they are arranged in the landscape
5. the nature of the microclimate: temperatures, rainfall, frost, hail etc.
6. the water availability on site
7. impact on surrounding areas

##### **Socio-economic Assessment**

1. the interest of the community
2. community demographics (age, culture, gender)
3. will the project intervention be socially and culturally acceptable?
4. current knowledge base of the community regarding climate change issues

5. the impact of project activities on surrounding communities

### **Institutional Capacity**

1. what types of operational and institutional infrastructure exists?

### **Financial feasibility**

1. scale of project activities, are they financially feasible?
2. exploration of funding mechanisms

## **STEP 5**

### **GIS And Remote Sensing**

#### **A relational database (Geodatabase)**

GIS is described as a technological instrument that is computer based and deals with the collection, retrieval, conversion, analysis, modeling and display of spatial data (ESRI, undated). The relational database is different from other one dimensional databases as it has a linking functionality that allows for varied applications (Figure 6.3). Its functionality allows the user to archive, sort, retrieve, manipulate and analyze data so as to fulfill the needs of the client or project. A carbon sink reforestation project involves an extensive amount of data collection, archiving and analysis. Therefore a relational database is the most appropriate tool for data manipulation.

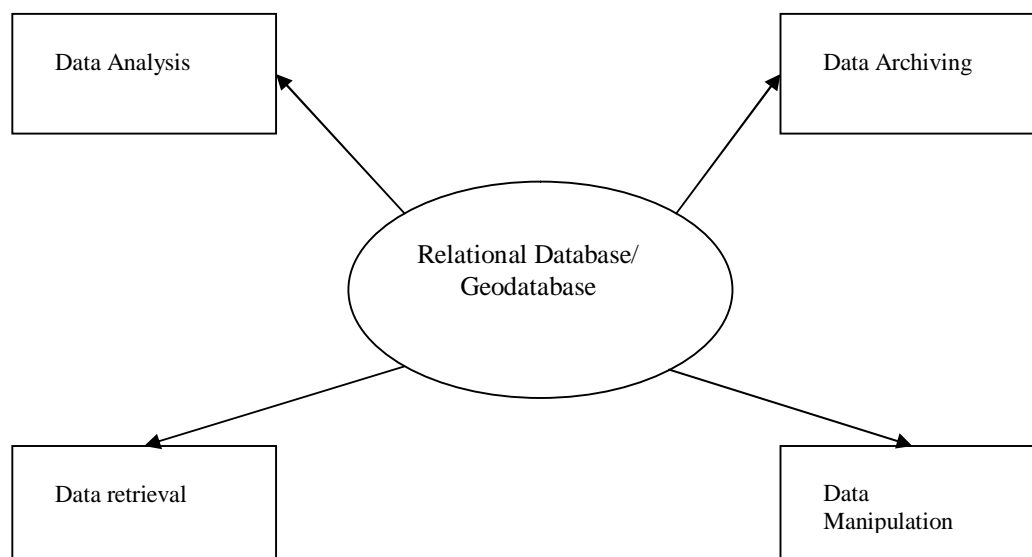


Figure 6.3: Relational Database/ Geodatabase Functionality

Apart from the importance of incorporating a relational database as a project function, the use of GPS technology is important as it provides a basis for ‘ground truthing’ the data at the project site at any given time. Incorporating GPS technology adds to the scientific integrity of the information that is collected, archived, manipulated and analysed in the project process. All sample plots in the designed field sampling methodology will require a GPS waypoint, and a track, to ensure that the plot can be found at any given time for future reference. The collection of all the GPS data needs to be in the correct format, and in the case of using the GPS in dense forest, where there is a dense canopy cover, one should ensure that the GPS is able to receive clear signal by either moving around within the plot until readings can be collected or moving to an open area nearby to retrieve the data required. Alternatively as technological advancement is achieved in the GIS community, these should be incorporated into the project process to update the technological capacity of the project. This will also improve on the monitoring and evaluation aspects of the project.

## **STEP 6**

### **Choosing reporting guidelines / systems to follow**

The IPCC AFOLU and LULUCF guidelines are specifically set out for Annex 1 parties (developed countries) reporting and accounting, and appear to be the best point of departure when attempting to undertake carbon stock change accounting. The recently published datasets for use in the IPCC guidelines<sup>3</sup> prove to be a more simplified tool for extracting the correct information when implementing reforestation projects.

Other guidelines such as the CDM simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the CDM implemented on grasslands or croplands ARAMS0001; and the revised approved afforestation and reforestation baseline methodology AR-AM0001, make for easy carbon stock calculation and monitoring. Below are a few examples of the proposed prescribed literature to reference when attempting to calculate carbon stock changes:

- IPCC GPG LULUCF Guidelines (1996, 2003)

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<sup>3</sup> Full references for the specific guidelines can be found in the reference list

- CDM-AR – small scale methodologies (ARAMS0001)
- Climate, Community and Biodiversity Project Design Standards (2005)
- Netshiluvhi T. R. and Scholes R. J. Allometry of South African woodland trees (2001)
- FAO and Winrock International methodologies, Sandra Brown

## **STEP 7**

### **Carbon Calculations**

One would first have to determine the land use category change the project will follow (i.e. crop to forest), and choose the appropriate guidelines. The guidelines are structured to follow a ‘tier’ approach so as to accommodate the data available or lack thereof. The project developer / expert will determine which equations are to be used at the end level accounting (i.e. the final carbon stock change equations), and work backwards from these equations until all variables in the equations are dealt with. Each variable in the final chosen carbon stock change equation is connected to a related equation. All the variables need to be reduced to their individual components to assess what data needs to be collected to fulfil the equation requirements. In so doing the sampling strategy is simultaneously derived. This will then yield a result for that variable. The variable will then be entered into the final equation until all variables are entered. Once this process is complete, a final carbon stock change result can be yielded (Figure 6.4).

The sampling strategy and accounting methodology should be designed to feed directly into the equations until they satisfy the 'final carbon stock change' equations – at which stage one will reach the final carbon stock change figures. It is assumed that any national accounting required can be extracted from the calculated data.

### EQUATION 3.2.21

#### ANNUAL CHANGE IN CARBON STOCKS IN LAND CONVERTED TO FOREST LAND

$$\Delta C_{LF} = \Delta C_{LFLB} + \Delta C_{LFDOM} + \Delta C_{LFSOils}$$

Where:

$\Delta C_{LF}$  = annual change in carbon stocks in land converted to forest land, tonnes C yr<sup>-1</sup>

$\Delta C_{LFLB}$  = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in land converted to forest land; tonnes C yr<sup>-1</sup>

$\Delta C_{LFDOM}$  = annual change in carbon stocks in dead organic matter (includes dead wood and litter) in land converted to forest land; tonnes C yr<sup>-1</sup>

$\Delta C_{LFSOils}$  = annual change in carbon stocks in soils in land converted to forest land; tonnes C yr<sup>-1</sup>

To convert tonnes C to Gg CO<sub>2</sub>, multiply the value by 44/12 and 10<sup>-3</sup>.

(Penman *et al* 2003:3.51)

Figure 6.4 Annual carbon stock change equation showing all related variables required to yield a carbon stock change.

### STEP 8

#### Create a field sampling methodology

The sampling methodology should be consistent with the time, cost and principles of a project. It is left to the discretion of the implementing organization to choose these methods as it is recognized that all project areas will be different in terms of the biophysical elements, socio-economic dynamics, and micro-climate.

The carbon pools to be included in the project needs to be assessed and either included or excluded based on their positive contribution to the removals required from the project. For example, if the cost of measuring and monitoring the soil carbon pool outweighs the benefits, it is suggested not to include this carbon pool in the first stage of the project. It is more beneficial to investigate the potential of including certain carbon pools at a later stage when the project is more sustainable. This is advised so as to reduce costs and increase benefits.

## **STEP 9**

### **Assessment of Local Policy and Legislation**

Due to the legal nature of such projects, it is important to undertake a thorough assessment of all the policies and legislation that may affect the project, such any Environmental Acts or land tenure policies. Issues such as land tenure are of a varied nature globally and numerous state and traditional laws govern the use of land. This is supported by Rahlao *et al* (2012:26) where it is clearly stated, “Unlike in many parts of Africa, the South African land tenure system provides a different but complex issue as far as REDD+ is concerned. The South African land ownership is unique and racially orientated since the 1960s to the 1990s, and is still very much in evidence today”. It is in the interest of the project to consider the land tenure issues in the country once a project site is determined, and what activity the land is to be used for in future. This is to protect the interests of the financial component of the project and to reduce losses. It reduces the adverse long terms socio–economic effects against all stakeholders involved. It is important as pointed out in the project timeline (Table 6.3), that all related and relevant policy and legislation be consulted during the project cycle to confirm that the project is still within the bounds of all the national and local laws. This is a precautionary step to avoiding any shortfalls encountered during the project.

## **STEP 10**

### **Standard Operating Procedures (SOP)**

Once the project takes shape and the activities are in place, it is recommended that a manual known as a SOP be created. Many versions of this manual will be created during the project process as the activities of the project mature. Taking into consideration that these projects are not of a rigid nature, the SOP should make provision for improvising and flexibility. This however, must be undertaken with caution so as not to jeopardize the projects activities in an adverse manner.

There are numerous stages the SOP will go through. These are:-

The Planning stage: it is important that the SOP document first go through a planning session. This will aid in the progression through a process of explaining each

procedural step. It is in the planning stage that quality assurance will be designed and outlined thereby making it easier to assess the integrity of the project.

The preparation / writing stage: where one will compile all steps taken in detail. The most important aspect of this particular stage is to achieve clarity and consistent terminology. This will aid in helping the user retrieve information faster, instead of having to read through unnecessary information. Each activity must be outlined and sub-divided into steps for easy viewing. A digital and a hard copy must be available to the author and users.

Drafting stages: when drafting the SOP, one will need to consider the graphical format in which the information will be presented. It is during this stage that the author of the SOP will interact with the users of such a document during field work and implementation of the project. Interactive field exploration whilst still in this stage of drafting a SOP will provide a clearer picture of the situation in the field. Once this initial stage is complete, the field staff and community members involved in the project should be provided with a copy of the document and asked to review and advise on its usefulness. The project manager/ author at this point should make use of the SOP in the field and ensure that it is understood by those that will be considered the 'users'. At this point their input should be incorporated and a new draft should be created and tested. After a back and forth process of this nature, a final draft will be produced. A copy of the final draft should be stored by the organization and be accessible to all involved in the project.

Reviews and audits are necessary to ensure that the SOP document is up-to-date and in current use. Quality Control and Quality Control aspects should be considered at every stage of the project process and detailed within the SOP. This will aid in maintaining the quality of the data through each stage of the project implementation process. Proposed methodologies for QA/QC can be found in various published forest carbon methodologies as pointed out by Diaz and Delany (2011).

The study has revealed that efficient and successful implementation of carbon sink reforestation projects involve a high degree of technical sampling and calculations; and extensive stakeholder engagement on various levels throughout the project

process. Chapter Seven gives a detailed account of the analysed results in relation to the to the actual theoretical expectations created by existing literature when implementing carbon sink reforestation projects.

## Chapter Seven

### Discussion and Conclusions

#### 7.1 Discussion

As stated by Birdsall (1996), our actions have consequences far beyond the visible and the immediate in the world. These consequences are rapidly becoming a reality in the twenty-first century through loss of biodiversity, deforestation, exacerbation of poverty and socio-economic decline.

As a result of excessive anthropogenic carelessness with regard to greenhouses gas emissions, numerous technical mechanisms have to be devised to deal with this growing problem. Mechanisms such as the CDM, carbon sequestration, CCS, and REDD+ are such initiatives that attempt to reduce carbon emissions or increase carbon stocks. As articulated by one of the industry experts, *'Climate Change crosses borders, and connectivity can be used in positive ways to get action'*. One of these being carbon sequestration, and as stated throughout this research and by Kobayashi (2004: 154) "Carbon sequestration is not a new technology. It is an existing technology in the early stages of commercialization. Given its potential impact on the future environment and human welfare, the importance of this technology is still underestimated". This raises concern on many levels as expressed in one of the responses which revealed that, *'government is not dynamic enough and lacks the incentives needed for South Africa to compare against other leading developing countries'*. Furthermore the most interesting observation was that implementing organizations are involved in this type of work both directly and indirectly, and lack a considerable variety of expertise required for success of these projects, for example *'community work engaging with landowners and access to technical experts were needed'*, *'the organization lacks the man power and community organizing background'*, and *'Geographical Information Systems (GIS) and Remote Sensing specialists are needed'*.

The Mkuze River Floodplain Carbon Sink project has an immense potential to fill the technical and socio-economic gaps that currently exist regarding the lack of country specific information. This is shown by the fact that the project team has taken the

stance of including the local community in the project financials and design. This is further supported by the FAO (2008:4) where it is stated that active participation of communities in all aspects of forest management will contribute to the efficiency, sustainability and equity of forest based measures to tackle climate change. Thus far it seems that this method of inclusion of locally affected communities is successful. In a similar manner, the World Bank Forest Carbon Partnership Facility (FCPF) is dedicated to creating 'REDD+ readiness' in target countries through technical assistance. (Rahloa et al, 2012:28). This model of 'developer incentives' has been taken up by the Mkuze River Floodplain Carbon sink project, and has thus far provided viable returns for the community for doing exactly that, 'promoting, maintaining and monitoring' forest preservation (Ramanand, 2007). At a project level, the majority of the participants suggested that the best way forward to initiating such projects was to incentivize payment to communities for the storage of carbon. This is a key feature of the Mkuze River Floodplain Carbon Sink project (Wildlands Conservation Trust, 2007).

However the current outlook from industry is that the South African government lacks significant technology, capacity and finance to effectively manage national forest carbon sequestration regimes. What is concerning is that many communities are already participating in these projects with the promise of a sustained livelihood. However, without proper technology, capacity and finance, it begs the question, 'where does this leave our forests and our people in this global crisis in the long term, will there truly be sustained livelihoods and socio-economic benefits?' An interesting observation was that most participants saw NGO bodies in the 'driving seat', contrary to the discussions occurring at the United Nations level, that assume Governments will take leadership.

In achieving the second objective of the research, it is recognized that roles, responsibilities and community participation are fundamental points of departure for the success of these types of projects. With reference to the Mkuze River Floodplain Carbon Sink project, all community member stakeholders regard stakeholder participation as a significant building block to the success of any project. They are deemed the main stakeholders as they are predominantly a forest dependent community using the forest for fuel wood, fencing material, food and medicinal

purposes. Thus, the community needs to participate in finding a collective solution to conservation of the forest. A disconnect amongst the 'climate change practitioners' of the world and the people they perceive as participants of such projects can occur at any stage of implementation through a lack of or no communication. One cannot expect the carbon to be sequestered for the stipulated time periods, whilst the project participants have their own timeline and agenda for the utilization of the trees if the objectives of such projects are not explained in detail to project participants. It is therefore important that the message of sequestration and project timelines, carried by such projects is clearly explained to potential project participants and that it is fully understood. Without communication as a fundamental building block, a project will encounter operational problems and increasing leakage issues reducing the confidence in the accounting for carbon stock changes. Therefore the manner in which information is disseminated to potential project participants must take into account various aspects such as: - respect, levels of literacy, creating an environment that breeds openness and levels of engagement that remain demographically and age appropriate.

Stakeholder participation and project implementation are not mutually exclusive but are rather considered as interconnected concepts. The notion of stakeholder participation in the project process is supported by Diederichs *et al* (2009) and Tucker (2001) as it was indicated that participation at all levels is important in the project process. Many of the responses received from the community project participants revealed that these types of projects provided them with a sense of belonging and hope, with the majority of the responses expressing their gratitude for the knowledge they gain, such as, '*I will get my hands and mind busy*'; '*it helps us to get more knowledge*'. It is evident that all the participants felt a sense of pride and joy in their ability and skills to be a part of the Mkuze River Floodplain Carbon sink project. The levels of contentment is high as project participants reflected that doing something to actively restore their environment makes a positive difference to their lives. This is an indication of the positive difference such an activity can have on a person's well-being. The participants' desire for education was also revealed throughout the interviewing process, which reflected their need for knowledge dissemination throughout the project implementation and operation. Coupled with effective participation is the need for the elements of technology, capacity building and finance.

The connection between the need for proper technology, capacity and finance and the positive effects these projects have on communities need to be acknowledged and harnessed to achieve long term sustainability and success. To gain the buy-in from close knitted traditional communities is difficult, The key component of success for such projects is the manner and approach taken to introduce such projects to communities. This is supported by the community's expression of trust and faith in the implementing organisation in this specific research. "Wildlands already has such a good relationship with the KwaJobe community, and that's what's going to make this project successful", says Sarisha Ramanand, who joined the Trust in June last year as their 'Carbon Sink Development Manager' (Wildlands Conservation Trust, 2007). This is illustrated by the following responses, *'I only want people who I know I can trust, not just anyone'*; *'I know you guys and I want to work with only you'*.

Communication structures built over time by the implementing organization with the community, is key to the success of any such project, especially one as complex as a carbon sink reforestation project. One cannot achieve long term success of any initiative if project participants are not comfortable with, and trusting of, the implementing organization. This needs to be considered to ensure long term sustainability and success. It can therefore be deduced that the sustainability of such projects is highly dependent on the participating agents and the objectives of carbon sequestration projects take this into account. However, one must not forget that the main purpose of such projects is to reduce carbon emissions and increase carbon stocks. The TAR and 4AR (Figure 2.1) show a clear connection between the projected and observed rising GHG emissions, this is supported by Boko *et al* (2007) and Kobayashi (2004) who point out the warming trends for South Africa.

Therefore, apart from these types of projects bringing socio-economic co-benefits to communities, one should not forget the inherent link to the carbon trading system and its implications. Hence, if properly designed, emissions trading can effectively reduce their abatement costs while assisting Annex I countries in achieving their Kyoto obligations (Zhang, 1999). This then adds to the objective of the FCCC, which is to stabilize GHG that are not dangerous to the planet (Pathak *et al* 2000). It is pointed out by Fearnside (2001), McHale *et al* (2007) and Brown *et al* (1996) that

constructing baselines and recognizing the role of forests are important steps towards building sustainable carbon sequestration projects. Although there are LULUCF guidelines (The Marrakesh Accords, 2001), there are currently no local South African procedural guidelines for constructing such projects, which are fundamental to proper and effective implementation (Aukland *et al* 2002 and Brown *et al* 2002). This research aimed to fill this gap by producing a guideline which outlines the procedural steps one must take to initiate, implement and manage such projects in the South African context (Chapter Six). This is related to the achievement of the second and fourth objective of the research.

Numerous negative views exist regarding the issues of carbon sinks, carbon trading and carbon offsetting due to the issues of leakage and non-permanence. However, Jansson and Nohrstedt (2001) indicate that forests, wetlands and lakes, which together cover approximately 53 percent of the Stockholm county region, can accumulate approximately 41 percent of the CO<sub>2</sub> generated from traffic and 17 percent of total CO<sub>2</sub> emissions from the population. Although it is evident that natural sinks reduce atmospheric CO<sub>2</sub>, the financial implications of such projects are far reaching. This is further supported by responses received from South African industry experts, as it was mentioned that funding forest projects is often more difficult than other energy related carbon trading projects. This is supported by Sandor *et al* (2002), who states that GHG markets will likely go through numerous iterations as technology, capacity and finance improves. This, however, has the potential to hinder progress in such projects as financing such initiatives is fundamental to their success. This is strongly supported by one of the responses received, which states, '*carbon projects that do not benefit local communities in a real way will only lead to more carbon emissions elsewhere as people need to make a living*'.

This is a clear indication of how important it is to address such fundamental issues during the initial phases of the project. Although Philibert (2000) makes a good case as he points out that economic uncertainty in negotiations serve as a key hindrance for issues such as start-up finance. As a result of this concern, in the case of REDD+, a REDD Plus partnership was formed to deal with fast-tracking the implementation of activities that support reducing emissions in forests. Whether this is the answer remains to be seen in forth-coming meetings of the partnership (REDD Plus

partnership, 2010). More importantly, all revenue-generating projects need to prove additionality.

In this case, additionality refers to the project activity contributing to additional carbon sequestration. Start-up technology and finance is fundamental to sustaining these types of projects in the initial phases and the long term, and the role of the government is crucial when it comes to mobilizing such tools. Whilst there is a vast array of scientific and technical information available to support the case of natural sinks, there is a lack of research into the social aspects of these project types. According to Kelman (2009), indigenous peoples have successfully adjusted to social and environmental changes over time. This is what is expected by carbon sequestration projects. It is important to recognize the participation of local communities as a fundamental building block to the success of such projects. However, a more detailed evaluation of local stakeholder participation in the design element of these projects is required.

Bass *et al* (2000 cited in Unruh, 2008:703) maintains that, “if large areas become managed for long-term carbon storage, local people will lose access to land, food, and fiber”. In this regard, the clarity and predictability aspects needed for carbon afforestation and reforestation and the supporting forms of land tenure, are the opposite of what would most benefit the rural poor in Africa. In contradiction to this statement, however, is a good point made by one of the industry participants, *‘if interest is created at a young age with regard to these types of projects, these types of initiatives could become a real sector of work such as becoming a doctor or accountant’*. We as a society should start to think outside the box. If reforestation carbon sequestration projects offer a triple bottom line positive effect, they should be taken seriously as any other sector of work is. Reforestation and climate change work is fast becoming a sector of its own and should be given equal status when attempting to move into a green economy/ low carbon society.

Carbon sequestration could be a very powerful tool to reduce rural poverty in developing countries. This can be achieved by channeling funding into carbon sink reforestation projects that allow for alternative livelihoods (Kobayashi, 2004). It is important for project developers to explore the socio-political background of the communities they propose to work in so as to understand the issue of land tenure in

that particular region. “In African smallholder tenure systems, trees are planted to delimit clear boundaries and to establish or increase security of tenure” (Unruh, 2008: 703). This is evident in the case of the Mkuze River Floodplain Carbon sink project as participants first engaged in planting on the boundaries of their land plots.

“One-on-one and small group interviews successfully facilitated participant-researcher knowledge exchange, catalyzing further knowledge sharing between community members” (Warrick, 2009: 83). This was clearly evident amongst the KwaJobe community as their responses revealed similar ideas and knowledge sharing. International and national institutions and mechanisms need to cater for stakeholder participation at all levels so as not to exclude stakeholders from the design of a reforestation project. This can be achieved at the local level in the form of community or stakeholder workshops at the initial stages of a project. Engagement with the relevant stakeholders holds significant value in the project process. Greater emphasis on stakeholder engagement is required to effectively communicate content, interpretation, and limitation of short-term forecasts and longer-term down-scaled projections to all stakeholders involved in the project process (Tschakert and Sagoe, 2009). This implies better collaboration between researchers, implementing agencies, NGOs, media people, and rural extension services.

Community project participants revealed interesting relationships with the project and their livelihoods, as many mentioned the lack of rain this season and how it has not only affected their project activities but also their ability to survive. The significance lies in the fact that they linked this lack of water availability to climate change, as shown by the following responses, *‘The climate change, the rain they not raining in general times’*; *‘in this year no rain’*; *‘In this year there is shortage of rain’*. Such responses support Bhaskar’s (Jefferies 2011:3) philosophy of critical realism through the expression of the participants’ personal experiences. The use of the critical realist approach has aided how information dissemination during the project phases occurred. This has allowed participants to explore various options when assessing the irregularities of their micro-climate. This has implications not only for the community and their livelihoods but also for the technical aspects of the project. Technical capacity will not be improved as originally anticipated if the trees are not offered an adequate chance to grow and store sufficient amounts of carbon. This is a clear

indication of the amount of resources required to initiate a reforestation project that boasts carbon reduction benefits. This is shown by Ometto *et al* (2005), as it is stated that the evaluation of residence time for carbon in vegetation is critical for carbon storage calculations, thus growth rates and stand ages are essential measurements for carbon dynamic studies. It is important to recognize the linked and interdependent technical elements required to achieve success in these types of projects.

The integration of social, economic and environmental interactions is difficult to understand and technically complex. The lack of South African policy on this issue surfaced as a contentious issue despite South Africa embarking on a national climate change policy. Chapter five highlights that there is evidence that there is a fundamental gap in policy formulation and legislation making in South Africa regarding carbon emission reductions and dealing with climate change. This is evident at the local operational level in particular, again affecting a country's ability to manage and implement the technical and financial aspects of a project of this nature. Many of the industry experts involved in the creation or implementation of carbon reduction/ sequestration projects are employed by environmental organizations that have not attempting to develop any policy aimed at reducing their own carbon emissions. This is a very important finding of the research as it shows the lack of will to 'practice what you preach', and is a danger to the ultimate success of behavioural change. "Carbon sequestration, therefore, should be understood as a part of many policy options in addressing global climate change" (Kobayashi, 2004:153).

The first objective of the research required interrogation of local policies that affect carbon sequestration projects. It must be noted that the South African National Forest Act does not provide the area, size, distribution or area cover in its definition of forest, but defines a forest as three or more trees in a connected canopy. This inadvertently makes it difficult at a national level to implement projects on a larger scale, such as a national REDD+ initiative as it is difficult to ascertain what types of tree cover to include in the baseline assessment. One requires a baseline of carbon stock figures to attain the difference in carbon stock changes upon the implementation of carbon sequestration projects in the landuse sector. A lack of detail within a country's definition of forest could render difficulty when attaining a baseline for reforestation carbon sequestration projects

Aside from policy changes which are in dire need on the continent of Africa which houses large areas of forest, it must be noted that countries such as South Africa which do not boast large forest cover still have a major role to play from a technical standpoint. This is true in the case of South Africa serving as a crucial role player in global discussions. South Africa is a major support base for the rest of the African continent, especially when crucial decision making moments fail to materialize global legally binding agreements as in the case of COP 15. It is clear from this research that the social elements of such project initiatives are in need of attention. It is mentioned in the introduction chapter that MDG number seven is to 'Ensure Environmental Sustainability', this has a clear and inherent link to the Initial National Communications (2003) which states that carbon dioxide is a significant gas to be dealt with in South Africa. This highlights our national responsibility to reduce emissions as set out by the UN. Although this research has predominantly been focused on sequestration projects, it has a direct technical implementation link to newer concepts such as REDD+.

Article 3 of the Kyoto Protocol (1998) is limited to afforestation / reforestation initiatives, therefore it is the responsibilities of governments to recognize the shortfall and negotiate for inclusion of REDD+. This is widely supported by industry experts as they believe the South African government should have a 'national approach to sinks'. It must be recognized that in the broader context, increasing GHG emissions is a global problem that has localized effects, and requires the world's attention and collective action. It is important to emphasize the multiple benefits reforestation sequestration projects and REDD+ projects have for communities. However, one must consider the negative consequences and ensure that all elements related to safe guarding the rights of indigenous peoples, biodiversity and socio-economic aspects to these types of initiatives are implemented. As pointed out by Lang (2011: par 1) more than 22 000 people in Uganda were evicted to make way for a carbon off-set tree plantation established by a London-based firm. While this is not a REDD+ project, it provides an early warning of how standards and safeguards can be willfully ignored.

This research highlights the technical and social aspects of reforestation projects, to enhance a country's ability in achieving successful implementation of such projects.

This is achieved through the following recommendations and through the use of a 'How to' Guide which is developed by the researcher for use by organisations attempting to implement carbon sink community reforestation projects. The guide has a twofold purpose, the first an overall implementation tool, and the second a detailed explanatory tool on how to incorporate full stakeholder participation in the project through each phase.

## **7.2 Recommendations**

A number of recommendations are provided as a guide to the establishment of reforestation projects.

1. Project developers / implementing organisations must consider that carbon sequestration reforestation projects will require facilitation of stakeholder groups that do not already interact in a coordinated manner. This will require extensive interaction with all stakeholders at differing levels, and requires the appropriate community development skills such as participatory rural appraisal techniques.
2. Transparency, open communication, expert elicitation, sufficient funding and meaningful participation are identified as the fundamental building blocks required for initial implementing phases. One of the most important elements to consider is the link between the costs, quality and time aspects of such a project. Project developers/ implementing organisations should plan in advance and take into account different scenarios so as to reduce the costs without marginalising the quality and moral integrity of projects. Projects should only proceed if the expected benefits outweigh the expected costs.
3. Take into account that carbon sequestration projects are associated with high risks, it is therefore important to form partnerships amongst different stakeholder groups and funding organisations so as to reduce the possibilities of risk. Thus, if the carbon part of the project fails there are other elements / activities, such as biodiversity conservation that may be a success. Another important aspect of partnerships is that carbon sequestration projects require appropriate business expertise, economic expertise, community development skills and ecological expertise.

4. A project of this nature is generally associated with intense activities, therefore activities such as the tree production and planting should be undertaken by different groups of people so as to create the maximum socio-economic co-benefit similar to the bartering system of the ITFL project.
5. Leading from the front is important to gain buy-in from the public. The country's leaders first and foremost need to believe in and emphasise how important it is to reduce GHG emissions. Thereby creating a more proactive approach towards participation in activities/ projects that lead to reduced GHG emissions.
6. The understanding of roles and responsibilities of all stakeholders must be made clear by the project manager at the onset so as to create as little or no confusion as possible. This reduces the risks of broader leakage aspects in projects, as projects should boast environmental integrity.
7. There are serious time lag issues with the delay of the effects of emissions, therefore policy is needed to guide all land use change practices. It is important to realise that incentives do sometimes fail; therefore legislation is required to fill the gap so as not to allow for leakage. A compliance mechanism and 'buffer' system should form part of the implementing system to create more comfort around permanence of carbon sink projects.
8. All projects of this nature should be expert and community-driven. This is due to the fact that communities are required to participate, however, the technical aspects do need expert input. Inclusiveness in the project process creates transparency.
9. Projects should be designed such that benefits of all projects accrue to the people that are directly involved in the project activities.
10. The findings of this research acknowledge the need for further research on the dynamics of communities and their involvement in such initiatives. This will aid in enhancing the scientific integrity and understanding of the subject matter in the local South African context, and enhance country-specific information databases.
11. The short terms and long term objectives of carbon sequestration projects, such as carbon emission removals and biodiversity conservation respectively, in the landuse sector need to be identified and integrated into (1) the project design and (2) introduced and explained to project participants in detail.

12. A scoping exercise should be undertaken to identify linkages with South African climate change policy and its associated information flows into national systems such as the Greenhouse Gas Inventory.
13. A scenario building exercise that identifies incentive based options and approaches should be undertaken. This could involve identifying opportunities and limitations to different approaches in the LULUCF sector; incentive based approaches in the LULUCF sector and Carbon offset mechanisms/ instruments that facilitate project success in the South African landscape.
14. An economic / financial feasibility analysis revealing opportunity costs and risks should be undertaken that assess advantages and disadvantages of Programmatic approaches versus small scale individual sequestration activities. These projects work on a scientific carbon-based accounting system that relies on the total area planted. Project developers / implementing organisations must identify and consider the area to be replanted / planted and assess whether the benefits break even with the initial inputs made, to ensure that the costs of the project do not out-weigh the benefits.
15. A socio-economic analysis should be undertaken to assess the social and cultural acceptability of implementing carbon sequestration projects in different cultural societies.

### **7.3 Conclusion**

According to Kobayashi (2004), although terrestrial sequestration is still a poorly understood field and much uncertainty remains regarding the mechanisms required to improve of terrestrial ecosystem sequestration, carbon sequestration could be a major component of climate change mitigation policy along with expanded renewable energy service and efficient energy use. It is evident that these types of projects have both positive and negative aspects to the implementation and operational phases. This research has unveiled both positive aspects of carbon sequestration reforestation projects and the difficulties that underpin their success.

According to the Kyoto Protocol, Sweden is reducing CO<sub>2</sub> emissions more than is required and has the right to increase their emissions by 4%. Instead, Sweden has set a goal of reducing emissions by another 2% over a 10-year period. This commendable effort is an example of a nation that goes beyond economic and equity concerns, to

recognize the absolute necessity for every country to mitigate CO<sub>2</sub> emissions at maximum capacity to minimize the effects of greenhouse gases on our life-supporting biosphere (Jansson and Nohrstedt, 2001). With this being said it must also be mentioned that Sweden is considered a developed country and has access to the fundamental start up tools, that is, finance, capacity and technology. Whilst for Africa this is still an issue that must be overcome, along with the continent's need for food security, poverty alleviation and education dissemination. Nevertheless carbon regimes in this century will continue to grow in size and complexity.

Apart from creating projects to reduce carbon emissions, it must be recognized that ecosystem management is the ultimate tool upon which carbon sequestration reforestation projects should be built. This is so that all aspects of the environment and its surroundings are accounted for. This is supported by Kobayashi (2004), as it is stated that ecosystem management is of greater importance in terrestrial carbon sequestration, and this will arguably generate synergy with other environmental issues, in particular, the synergy between biological diversity and terrestrial carbon sequestration. Therefore biological diversity is conserved, socio-economic issues are accounted for and there is a reduction in the atmosphere's greenhouse gas content. The positive energy generated amongst all community members reveal that a 'green economy' involving environmental job prospects is a real and tangible possibility for South Africa if implemented correctly. The potential for success of environmentally friendly based work within the 'green economy' concept can be enhanced with increased support from all stakeholders.

South Africa's historical position has resulted in the country moving through different discourses over a short time period. According to Hallows (2002), these discourses were Neo-Liberalism, Sustainable Development and Environmental Justice. The message remained consistent, 'clean up the environment and make a better world for all'. In our quest to do exactly that, we are creating numerous technical and complex mechanisms to help us achieve our goal. However, rarely do we consider the fundamental building blocks required for the success of achieving global environmental sustainability. Stakeholder participation proves to be the most powerful tool in the success or failure of carbon sequestration reforestation projects, which anticipate the participation of local communities.

Unruh (2008) pointed out that the expectations for afforestation and reforestation carbon sequestration in Africa needs to be significantly reworked and brought more in-line with ongoing realities. “The challenge is to find ways of combining indigenous and scientific knowledge to help in successful adaptation at community level” (Kelman, 2009:41). The lessons learnt and details highlighted in this research support Kelman’s (2009) statement. These findings and deductions will assist in achieving a more realistic attempt at success with regards to such projects.

The theoretical framework, results and discussion have aided in achieving an improved understanding of carbon sequestration reforestation projects. The research has taken full account of stakeholder participation and has filled the gap identified in the introduction chapter. This is evident by the results gained in Phase Two of the data analysis. The main aim of the research has been achieved through the comprehensive evaluation of perceptions of participants; and the enhanced insight into the procedural implementing steps required for initiation, implementing, managing and sustaining such projects. As a result this research project will aid in better decision making, and provide direction to implementation activities of such initiatives. As once stated by Charles Darwin, ‘It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change’ (Robinson, 2010:3). Local communities, governments and civil society play a significant role in landuse decision making processes in a changing world. The participation of various levels of stakeholders is essential to the success of such initiatives and must not be underplayed, ignored or merely paid lip-service.

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# APPENDICES

## Appendix 1.

Vegetation Dry Moisture content results. Dry Weight is then calculated using the moisture content figures.

Copy of Sample results.		Plant Laboratory, Private Bag X1 Margaret Parker Telephone 033 3559 448																
For:		Sarisha Ramanand, Box 1138, Quarry Centre, 3245																
39595		100% Dry Matter Basis Summary of analytical results																
Sample ID	Lab ID	C %	S %	N %	Ca %	Mg %	K %	Na mg/Kg	Zn mg/Kg	Cu mg/Kg	Mn mg/Kg	Fe mg/Kg	P %	Al mg/Kg	B mg/Kg	Ash %	Moist %	pH
M Zandi Plot	P1205																51.06	
M Zandi Plot2	P1206																69.28	
Philisiwe Plot2	P1207																9.86	
Thelma Plot2	P1208																10.91	
Sibongile Plot	P1209																8.89	
Sibongile Plot2A	P1210																10.10	
Sibongile Plot2B	P1211																9.17	
Jasselina Plot1	P1212																9.79	
Jasselina Plot2	P1213																9.80	
Jasselina Plot3	P1214																9.65	
Gerald Plot2	P1215																9.22	
Themba Plot1	P1216																45.78	
Themba Plot2	P1217																52.07	
Dudzile Plot1	P1218																9.41	
Nsukwini Plot1	P1219																13.74	
Nsukwini Plot2	P1220																17.57	
Forest 4	P1221																11.10	
Zebron J Plot1	P1222																16.62	
Zebron J Plot2	P1223																10.05	
Zebron J Plot3	P1224																9.68	

**Appendix 2.**  
Soil Texture Analysis

**KwaZulu-Natal Department of Agriculture and Environmental Affairs**  
Soil Salinity Laboratory, Soil Fertility and Analytical Services  
Private Bag X9059, Pietermaritzburg,3200  
Tel. 033 3559465

Name: 

Sarisha Ramanand
P.O.Box 1138
Quarry, Hilton,
Tel:033-3436380



Date:23/05/2008

**PARTICLE SIZE ANALYSIS**

**According to:- Soil Classification, A Taxonomic System For South Africa 1991**

Laboratory Number	Sample ID	Clay % (<0.002 mm)	Fine Silt % (0.02 - 0.002 mm)	Coarse Silt & Sand %		Texture Class
				(0.02 - 2 mm)	Sand %	
24494	Jabu P1	10	4	86		Clay Laom
24495	Jabu P2	6	2	92		Sandy Loam
24496	Jabu P3	6	1	93		Clay
24497	Thulani	10	4	86		Clay
24498	Aaron	10	6	84		Sandy Clay Laom
24499	thelma	30	12	58		Sandy Clay Laom
24500	Gerald	12	5	83		Sandy Laom
24501	Zeb. Jobe P1	43	36	21		Sandy Clay Loam
24502	Zeb. Jobe P2	49	32	18		Sandy Clay Laom
24503	Zeb. Jobe P3	36	37	27		Clay Laom
24504	Nseleni P1	8	2	90		Sandy Laom
24505	Nseleni P2	16	7	77		Sandy Clay Loam
24506	Nseleni P3	34	17	49		Sandy Laom
24507	Philisiwe	17	7	75		Sandy Clay Loam
24508	Forest 1	17	12	71		Sandy Clay Laom
24509	Forest 2	30	41	29		Sandy Clay Loam
24510	Forest 3	6	1	94		Clay

### Appendix 3.

Carbon, Nitrogen and Sulphur soil analysis.



KZN Agriculture and Environmental Affairs

uMnyango:  
weZolimo neZemvelo

ISIFUNDAZWE SAKWAZULU-NATALI

**Carbon, Nitrogen and Sulphur Results**

Private Bag X9059  
PIETERMARITZBURG  
3200

Enquiries: B. Mashiyana  
Telephone: 033 3559 537  
Fax: 033 3559 263

#### Client details

S. Ramanand  
P.O. Box 1138  
Hilton  
3245  
KZN

#### Advisor

Sample I.D	Total %carbon	Total %Sulfur	Total %Nitrogen
mzandi p1	2.35		
mzandi p2	1.78		
philisiwe2	0.42		
thelma 2	1.35		
sibongile1	0.24		
sibongile2	1.09		
jesselina1	0.48		
jesselina2	0.21		
jesselina3	0.36		
gerald 2	0.31		
themba 1	2.47		
themba 2	2.17		
duduzile 1	0.16		
nsukwini 1	2.18		
nsukwini 2	1.97		
forest 4	2.94		
jobe 1	2.26		
jobe 2	2.60		
jobe 3	2.10		

**Appendix 4.**



**School of  
Environmental**

**Carbon Sequestration Study Questionnaire**

*Welcome, thank you for being a willing participant in this study. Your participation and cooperation is highly appreciated as the results of this study will make a significant difference in fighting against the negative impacts of climate change in the developing world.*

**Name of Participant**

Do you wish to remain anonymous?

YES or NO

**Name of participating community and country**

<input type="text"/>	<input type="text"/>
----------------------	----------------------

**GENERAL QUESTIONS**

1. Do you know what Climate Change is?

YES or NO

What do you understand about climate change?

What do you think will happen or is happening to the environment around you because of Climate Change?

What methods would you like to see put in place to protect you from any bad effects of Climate Change?

2. Do you think trees and forests are important for our atmosphere and the world?  
YES or NO

Why do you say this?

**SPECIFIC QUESTIONS**

1. Do you feel the “Tree Planting” (Reforestation) project is good or bad?

Why do you feel this way?

**SPECIFIC QUESTIONS**

2. Why did you join the “Tree Planting” Project and how has it helped you? (If it has not helped you, state that)

In what way does the Tree Planting project help you?

3. How do you think the “Tree Planting” project can be improved?

4. If there was another type of “Tree Project” that helped the forests to remain where they are and keep growing, would you want to take part in that type of project?

YES or NO

Why do you feel this way?

5. Do you think community people who live near the forests would like to keep the forests where they are?

YES or NO

Why do you say this?

6. How does it make you feel when project managers ask you to be apart of these tree planting/ tree protecting projects?

**Appendix 5.**



**School of  
Environmental**

**Carbon Sequestration Study Questionnaire**

*Welcome, thank you for being a willing participant in this study. Your participation and cooperation is highly appreciated as the results of this study will make a significant difference in fighting against the negative impacts of climate change in the developing world.*

**Name of Participant**

Do you wish to remain anonymous?

YES or NO

**Name of participating Organisation**

Do you wish for the organisation to remain anonymous?

YES or NO

**Name of participating Country**

## **INSTRUCTIONS**

Please read the instruction sheet carefully so that the correct section is answered. Kindly email the completed questionnaire to the following addresses [203504138@ukzn.ac.za](mailto:203504138@ukzn.ac.za) and [sarisha.ramanand@gmail.com](mailto:sarisha.ramanand@gmail.com)

This questionnaire has been developed so that it can be completed electronically. It includes three (3) sections:

- Section 1 (Instruction sheet, introductory questions and a probability matrix to guide you to the correct section)
- Section 2
- Section 3

1) Step 1 – For ease and convenience, tick boxes have been provided. Spaces have also been provided for additional comments where appropriate.

A text box is provided for answers below every question. When you are ready to answer the questionnaire, place your cursor in the text box and begin typing out your answer.

2) Step 2 – Please continuously **SAVE** the document you are working with :o)

3) Step 3 – Please answer the questions in Section 1 below. The ‘YES’ and ‘NO’ answers from Q1 and Q2 that match the probability matrix provided in this instruction sheet will guide you to the section you will be required to answer thereafter.

### **Section 1: Introductory Questions and Probability Matrix**

1) Are you familiar with the concept ‘carbon sequestration’?

YES or NO

1.1) If yes, what do you understand by this concept?

2) Are you familiar with the concept 'carbon sink'?

YES or NO

2.1) If yes, what do you understand by this concept?

Thank you, this part of the interview process is now complete. You have also been forwarded/ emailed both Sections 2 and 3. You will be required to answer only one of them according to the probability matrix given below. Please follow the example below and proceed to Section 2 or 3.

### **How to use the Probability Matrix**

**Example:** If I answered yes to question 1 and yes to question 2 presented in Section 1 above, I would answer the document named **Section 2**.

3) The probability matrix:

	<b>Question 1</b>	<b>Question 2</b>	<b>Questionnaire to answer</b>
<b>Answers</b>	YES	YES	Section 2
	NO	YES	Section 2
	YES	NO	Section 3
	NO	NO	Section 3

*Please proceed to the section that matches your responses in the probability matrix.*

**Appendix 6.**

**Section 2: Carbon Sequestration Study Questionnaire**

**General Section**

1) Are you familiar with any global, national or local policies and protocols pertaining to carbon sinks and carbon sequestration?

YES or NO

1.1) If yes, briefly state/name the policies and protocols that are familiar to you?

1.2) If no, N/A

**Financial Section**

1) To your knowledge, are there any funding opportunities available to support national / local carbon sink reforestation projects?

YES or NO

1.1) If yes, where do these funding opportunities come from?

1.2) If no, N/A

2) Which organisations would you approach to fund/ invest in carbon sink reforestation projects?

2.1) Why would you approach such organisations?

**Project Section: General**

1) In your opinion, who do you think/ feel should lead carbon sequestration projects?

1.1) Explain.

2) In what manner/ how should carbon be valued to attract the interest and participation of the general public?

3) Has your place of employment factored in/ is factoring in/ is planning to factor in the reduction of carbon emissions into their core business structure?

YES or NO

3.1) Explain.

4) At your place of employment/ work is there any financial / technical opportunity to develop projects to reduce carbon emissions?

YES or NO

4.1) Explain.

5) Do you think there is a need for carbon sequestration projects / projects that reduce carbon emissions?

YES or NO

5.1) Explain.

6) Should carbon sequestration projects/ reforestation projects that reduce carbon emissions be:- (please write down your choice in the space provided)

- Expert driven
- Community driven
- Expert and community driven

6.1) Explain.

7) Do you think there is a need for collaboration/ partnerships when undertaking/ implementing carbon sequestration projects / reforestation projects that reduce carbon emissions?

YES or NO

7.1) Explain.

8) Which individuals/ groups from the general public/ society/ community would you approach to participate in a carbon sink reforestation activity?

8.1) Why would you approach these individuals?

**Project Section: Technical**

1) Is the organisation(s) you work for/ currently employed by/ have previously worked for, are/ have been involved in any carbon sink reforestation projects related to carbon sequestration?

YES or NO

1.1) If no, the following questions are not applicable

1.2) If yes, do you believe the organisation(s) has the technical skills, capacity and human resources to undertake/ implement these projects?

YES or NO

1.3) If yes, please state the type of technical skills, capacity and human resources the organisation possesses.

1.4) If no, what type of technical skills, capacity and human resources do you think is required to undertake/ implement a carbon sink project?

2) In your opinion, how should carbon sink reforestation projects be implemented to achieve optimum/ maximum success?

***You have come to the end of the questionnaire. Thank you for your patience, cooperation and participation in this study.***

## Appendix 7.

### Section 3: Carbon Sequestration Study Questionnaire

#### General Section

- 2) Are you familiar with any global, national or local policies and protocols pertaining to carbon sinks and carbon sequestration?

YES or NO

- 1.3) If yes, briefly state/name the policies and protocols that are familiar to you?

- 1.4) If no, N/A

#### Financial Section

- 3) Are you aware of any funding opportunities that support reforestation projects aimed at reducing carbon emissions?

YES or NO

- 1.3) If yes, where do these funding opportunities come from?

- 1.4) If no, where do you think such funding opportunities should come from and why?

- 4) Which organisations would you approach to fund/ invest in projects that are aimed at reducing carbon emissions?

- 2.1) Why would you approach such organisations?

**Project Section: General**

9) In your opinion, who do you think/ feel should lead reforestation projects that aim at reducing carbon emissions?

1.1) Explain.

10) In what manner/ how should carbon be valued to attract the interest and participation of the general public?

11) Has your place of employment factored in/ is factoring in/ is planning to factor in the reduction of carbon emissions into their core business structure?

YES or NO

3.1) Explain.

12) At your place of employment/ work is there any financial / technical opportunity to develop projects to reduce carbon emissions?

YES or NO

4.1) Explain.

13) Do you think there is a need for reforestation projects that aim to reduce carbon emissions?

YES or NO

5.1) Explain.

14) Should reforestation projects that aim to reduce carbon emissions be:- (please write down your choice in the space provided)

- a. Expert driven
- b. Community driven
- c. Expert and community driven

6.1) Explain.

15) Do you think there is a need for collaboration/ partnerships when undertaking/ implementing reforestation projects that reduce carbon emissions?

YES or NO

7.1) Explain.

16) Which individuals/ groups from the general public/ society/ community would you approach to participate in a reforestation activity that aims to reduce carbon emissions?

8.1) why would you approach these individuals?

**Project Section: Technical**

3) Are you aware of any companies/ organisations that are/ have been involved in any reforestation projects that aim to reduce carbon emissions?

YES or NO

1.5) If yes, explain / give details of such projects.

1.6) If no, do you think companies/organisations should be involved in reforestation projects aimed at reducing carbon emissions?

YES or NO

1.7) Explain.

1.8) What type of technical skills, capacity and human resources do you think is required to undertake/ implement a carbon sink project?

4) In your opinion, how should reforestation projects be implemented that aim at reducing carbon emissions, to achieve optimum/ maximum success?

*You have come to the end of the questionnaire. Thank you for your patience, cooperation and participation in this study.*

**Appendix 8.**  
**University of KwaZulu-Natal**  
**School of Environmental Sciences**  
**Informed Consent Document**



I, Sarisha Ramanand, am a student currently registered for the MSc degree at the Pietermaritzburg campus of the University of KwaZulu-Natal (UKZN). A requirement for the degree is a thesis and I have chosen the following topic:

The operational potential of carbon sinks in KZN, South Africa .

Please note that that this investigation is being conducted in my personal capacity. I can be reached on 203504138@ukzn.ac.za , [sarisha.ramanand@gmail.com](mailto:sarisha.ramanand@gmail.com) or 0727131528.

My academic supervisors are Prof. T. Hill and Ms. D. Trotter, based in the School of Environmental Sciences on the Pietermaritzburg campus of the University of KwaZulu-Natal. They can be contacted on 033-260-5341.

The purpose of this research is to shed more light on how to implement carbon sequestration projects at the local scale; through the investigation of 'what project developers are thinking/ have knowledge of or the lack thereof and what communities are thinking/ are not aware of - regarding the global "carbon debate". Information gathered in this study will include data retrieved from the interview and/or questionnaire that I request you to participate in. Please note that your name and the name of your organization will not be included in the report should this be requested, as only summary data will be included. Your anonymity and confidentiality is of utmost importance and will be maintained throughout the study.

Your participation in the interview is completely voluntary. You have the right to withdraw at any time during the study.

I appreciate the time and effort it would take to participate in this study. I would be very grateful for your participation, as it would enable me to complete my thesis and MSc.

**Please complete the section below:**

I ..... (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Signature of Participant.....

Date.....

**Appendix 9.**  
**Permission from Wildlands Conservation Trust**

Dear Sarisha

Sounds great.  
Kindest  
Andrew

CEO Wildlands Conservation Trust  
033 343 6380  
083 324 7484  
[www.wildlands.co.za](http://www.wildlands.co.za)

-----Original Message-----

From: Sarisha Ramanand [<mailto:sramanand@deat.gov.za>]  
Sent: 13 January 2010 10:47 AM  
To: Andrew Venter  
Subject: Masters

Hi Andrew,

I am unfortunately unable to physically carry out this phase of my research so I am currently trying to find and sort out a field person and the logistics to collect data from the JOBE community, with your previous permission.

The final questionnaire and all the details of the data collection will be sent to you so that you can 'sign off' on it as you mentioned below. The questions will be very simple and are bound by ethical clearance standards already signed off by UKZN - hence they will not be used for any other purpose other than this masters, A copy of my masters with the results will be sent to Wildlands if desired?

Please let me know if this is still ok?  
Thank you

Hi there

You're definitely welcome to use the jobe project for your research. However, you'll need to figure the logistics yourself as Graeme is already hectic. This would also be NB for your data integrity.

We'd also need to sign off on the questionnaires as your access to the community is being endorsed by wildlands.

Kindest  
Andrew

Sent from my BlackBerry® wireless device

-----Original Message-----

From: "Sarisha Ramanand" <[sramanand@deat.gov.za](mailto:sramanand@deat.gov.za)>

Date: Thu, 12 Nov 2009 13:20:31

To: <[andrewv@wildlands.co.za](mailto:andrewv@wildlands.co.za)>

Cc: <[charmainev@wildlands.co.za](mailto:charmainev@wildlands.co.za)>; <[graemef@wildlands.co.za](mailto:graemef@wildlands.co.za)>;  
<[susanv@wildlands.co.za](mailto:susanv@wildlands.co.za)>

Subject: Masters Query

Hi Andrew , hope you all are well

I wanted to know if the offer of using the KwaJobe community in my masters is still an option?

If yes, I would not be able to conduct the interviews in person it is not logistically feasible so I will need someone like Graeme (example) to distribute and collect the questionnaires again.

I will draw them up and post them to the Hilton office, and the Trust can invoice me when they are posted back to me again.

It is a very simple questionnaire and will be translated as well. The data will belong to me with confidentiality clauses attached to protect all participants as stated in my already signed ethical clearance forms, and the Trust will get a full copy of the Thesis if they want.

Please let me know if this is possible at all, if it is then I will send the stuff before I go to Copenhagen because its coming up quite soon.

If no, that's cool - no stress,  
Thank you,

Sarisha Ramanand

Advisor: Carbon sinks and Agriculture sector Mitigation

Air Quality Management: Climate Change Special Unit

Department: Environmental Affairs

Tel: (012) 310-3849

"Be the change you want to see in the world" Mahatma Ghandi