

A sustainable agricultural management framework for a biosphere reserve

DCS van der Merwe

 **orcid.org 0000-0001-7539-0910**

Mini-dissertation accepted in partial fulfilment of the
requirements for the degree *Master of Business Administration*
at the North-West University

Supervisor:

Prof I Nel

Graduation ceremony May 2018

Student number: 22829059

ABSTRACT

The state of the environment was identified as the most prominent global risk in 2017 by the World Economic Forum. This menace is exacerbated by the worldwide loss of natural habitat, biodiversity and ecosystem services to the ever-growing footprint of conventional agricultural activities. As the global population keeps on growing, the total demand for agricultural production will continue to expand accordingly, thereby increasing the negative effects of traditional agricultural systems on the environment.

The capability of sustainable agricultural practices to improve agri-production and to build ecological capital at the same time is well proven on field and farm level. To optimise the benefits of these practices, it must be integrated with the natural occurring ecological processes and replicated on the landscape and bioregional level.

Fusing sustainable agricultural practices with the UNESCO's biosphere reserve concept provides a strategy that can be implemented by a landowner-driven governance structure to improve agri-production and build ecological capital simultaneously on the field, farm, landscape and bioregional level. This model provides a sustainable multi-level agricultural framework to diminish the environmental risks and amplify the return on investments through creating integrated value for the bioregion.

It is clear from the study that sustainable agricultural practices compare very favourably with the same conventional agricultural systems due to lower input costs and higher yields. The main barriers preventing or delaying the migration to sustainable agricultural practices by the landowners in the region were determined to be the cost of capital, insufficient knowledge of sustainable agricultural practices and the uncertainty of implementing new systems.

Due to the extent and long-term nature of the proposed interventions, the implementation, evaluation and adaptation of this framework fall outside the scope of this study and will therefore form the subject of further study.

Key words: sustainable agricultural practices; agri-production; ecological capital.

Abbreviations

IIRC	International Integrated Reporting Council
IMSAS	Integrated Multi-Dimensional Sustainable Agricultural Systems
MAB	Man and Biosphere Programme of UNESCO
MBR	Proposed Marico Biosphere Reserve
MIRR	Modified Internal Rate of Return
MOU	Memorandum of Understanding
NPV	Net Present Value
NRM	Natural Resource Management
NWK	Noordwes Koöperasie
NWU	North West University
PI	Profitability Index
PV	Present Value
RSA	Republic of South Africa
SAMF	Sustainable Agricultural Management Framework
SENWES	Sentraal Westelike Koöperasie
WACC	Weighted Average Cost of Capital
WEF	World Economic Forum
UNESCO	United Nations Educational, Scientific and Cultural Organisation

Table of Contents

Abstract	ii
Tables	vi
Figures	vii
Maps	viii
Equations	viii
CHAPTER 1: INTRODUCTION TO SUSTAINABLE AGRICULTURE.....	1
1.1 Introduction	1
1.2 Problem Statement	1
1.3 The research objectives	4
1.3.1 Primary Objective	4
1.3.2 Secondary Objectives.....	4
1.3.3 A sustainable agri-management framework for the MBR: Article 1	5
1.3.4 Feasibility of the SAMF for the MBR: Article 2.....	5
1.4 Scope of the research	5
1.4.1 Field of research.....	5
1.4.2 Geographical Demarcation	6
1.5 Research Methodology	8
1.5.1 Literature Study	8
1.5.2. Research Approach.....	8
1.6 Limitations of the Study	9
1.7 Layout of the Study	10
CHAPTER 2: SUSTAINABLE AGRICULTURAL PRACTICE.....	12
2.1 Introduction	12
2.2 Definitions and Concepts	12
2.2.1 Integrated value, the different capitals and sustainability.....	12

2.2.2	General and Ecological Definitions	14
2.2.3	Sustainable Agricultural Practices delineated	18
2.2.4	Sustainable agricultural practices defined	19
2.2.5	Characteristics of sustainable agricultural systems	20
2.3	Ecological Profit	23
2.4	The challenges facing the present day agriculturalist.....	23
2.5	Conclusion	27
CHAPTER 3: A SUSTAINABLE AGRICULTURAL MANAGEMENT		
FRAMEWORK: ARTICLE 1.		
3.1	Introduction	28
3.1.1	Problem statement	28
3.1.2	Study objectives	29
3.1.3	Study method.	29
3.2	Literature review.....	30
3.2.1	The essence and functions of a biosphere reserve	30
3.2.2	MBR: The Business Model	35
3.2.3	The fundamental character of strategy	37
3.3	Results	37
3.3.1	Aim of the SAMF	37
3.3.2	The goals of the SAMF	38
3.3.3	The SAMF	39
3.4	Conclusion and recommendations	55
CHAPTER 4: IMPLEMENTATION OF THE SAMF: ARTICLE 2.		
4.1	Introduction	56
4.1.1	Problem statement	56
4.1.2	Research objectives	57
4.1.3	Research methodology.....	57

4.2	The financial feasibility of sustainable agricultural practices.	58
4.2.1	Literature Review.....	58
4.2.2	Results: The financial feasibility of sustainable agricultural practices ...	70
4.2.3	Conclusion.....	76
4.3	Barriers to the uptake of sustainable agricultural practices	77
4.3.1	Literature Review.....	77
4.3.2	Results.....	80
4.3.3	Possible Barriers and Potential Keystones: Conclusions	90
4.4	Conclusions and recommendations: Article 2	91
Chapter 5: Conclusion and recommendations.		92
Conclusions		92
Recommendations.....		92
ANNEXURE A: REFERENCES		A-1
ANNEXURE B: EXAMPLE OF SURVEY		B-1
ANNEXURE C: FINANCIAL DATA UTILISED		C-5

Tables

Table 1:	General Concepts.....	15
Table 2:	General and Ecological definitions	17
Table 3:	Sustainable Agricultural Practices	19
Table 4:	The major negative drivers to an irreversible ecological collapse.....	25
Table 5:	The land usages in the MBR	32
Table 6:	The guiding principles for the SAMF.....	38
Table 7:	The action plan to be implemented on biosphere reserve level.....	47
Table 8:	The coherent action plan to be implemented on landscape level	48
Table 9:	The coherent action plan to be implemented on farm and field level	54
Table 10:	Most suitable agricultural practices for the area of the MBR.....	67
Table 11:	Variables - financial feasibility of sustainable agricultural practices	68
Table 12:	Increase in live weight – meat production.....	69

Table 13:	Adjustment of Agro-ecology range for local Circumstances	69
Table 14:	Savings in water & electricity costs in orchards (ZAR).....	69
Table 15:	Changeable Values	70
Table 16:	Sensitivity Analysis	76
Table 17:	Internal reliability of the data.....	80
Table 18:	Survey results.....	86
Table 19:	Ten principle change management model.....	89
Table 20:	Conventional Agri-Practices–Annual Crops.....	C-5
Table 21:	Conservation Agri-Practices Annual Crops.....	C-6
Table 22:	Conventional vs Sustainable Livestock Practices	C-7
Table 23:	Conventional Agricultural Practices–Perennial Crops	C-7
Table 24:	Agro-ecological Practices–Perennial Crops.....	C-8
Table 25:	Comparison Agro-ecological Practices	C-9

Figures

Figure 1:	The negative and positive forces impacting on ecological resilience.	26
Figure 2:	Biosphere Reserve Zonation and Land use guidelines	32
Figure 3:	Governance framework of the MBR	35
Figure 4:	Business Model of the MBR.....	36
Figure 5:	The coherent actions to be implemented (Source: Own).	40
Figure 6:	NPV: conventional vs. sustainable practice	70
Figure 7:	MIRR: conventional vs sustainable practices.....	71
Figure 8:	Profitability Index: conventional vs sustainable practices.....	71
Figure 9:	Variance in NPV, MIRR & PI: conventional & sustainable practices .	71
Figure 10:	Comparison: Conventional Livestock vs Silvopastoral Systems.....	72
Figure 11:	Comparison - NPV: Conventional vs Agro-ecological systems	72
Figure 12:	Comparison - MIRR: Conventional vs Agro-ecological systems.....	73
Figure 13:	Comparison - PI: Conventional vs Agro-ecological systems	73
Figure 14:	Comparison of the NPV of sustainable agricultural practices	74
Figure 15:	Comparison of the MIRR of sustainable agricultural practices	74
Figure 16:	Comparison of the PI of sustainable agricultural practices.....	75
Figure 17:	Ten Principle Model of Change	90

Maps

Map 1: The location of the proposed MBR.....	7
--	---

Equations

Equation 1: WACC	59
Equation 2: After-tax cost of debt	59
Equation 3: Bond-Yield-plus-Risk-Premium	60
Equation 4: NPV	61
Equation 5: IRR	62
Equation 6: MIRR	63
Equation 7: Profitability Index.....	64

CHAPTER 1: INTRODUCTION TO SUSTAINABLE AGRICULTURE

1.1 Introduction

The World Economic Forum's Global Risk Landscape Matrix for 2017 estimates that four out of five environmental risks are at an above average likelihood of happening. It is also estimated that these risks will have above average negative impacts if they do happen (WEF, 2017).

These potential environmental hazards are further amplified by the factors of looming water and food shortages as well as biodiversity loss and ecosystem collapse which are all located above average on the impact scale and just below average on the likelihood range of the above-mentioned matrix. Closely positioned to these disturbing possibilities one finds the double barrel threat of unemployment and/or underemployment (WEF, 2017).

At the centre of this intersecting high-risk systems are the three interdependent subsystems of the agri-economy, the natural environment and the social structures that are responsible for sustaining life. This systems approach recognizes what traditional economics normally ignores - the whole economy is embedded in wider social and natural systems that are non-substitutable and in which social and ecological capital depletion is unfortunately irreversible. This agri-economy, natural and social systems are non-linear with a specific resilience threshold, which once crossed, makes the system normally cave in completely (Dodds, 1997:21).

1.2 Problem Statement

As the future profits and products of agricultural systems depend on the lasting quantity and quality of the natural assets that is currently being used for inputs the downwards spiral of social and ecological capital depletion mentioned above becomes steeper and steeper if resilience of the natural systems is not aggressively maintained (Worster, 1993:15).

This is exacerbated by the 145% growth of global agricultural production from 1960 to 2008 that provided the world population, which increased from roughly 3 billion to 6 billion humans over the same period, with more food available than in 1960. As the

world population continues to grow, the absolute demand for food will also grow, thereby speeding up the global loss of natural habitat, biodiversity and ecosystem services to the ever-growing footprint of conventional agricultural activities (Pretty, 2008:447).

In the last half a century, the global area under agriculture expanded with 11%, the livestock numbers and area under irrigation increased twofold while the chemical fertiliser use escalated sevenfold (Pretty, 2008:449).

Within the RSA, these efforts to align the agricultural production with the domestic demand for food have pushed this country way past the acceptable marine harvesting, freshwater use and biodiversity loss limits on local level, while we are quickly approaching the tolerable threshold for climate change, air pollution, phosphorus loading, arable land use and chemical pollution on national and global level (Department of Environmental Affairs, 2015:7)

To ensure a healthy environment and food security over the long term, the challenge will be to increase food production as well as the build up of ecological capital (Pretty, 2008:451). This ecological capital consists of provisioning services like “food and water, regulating services (flood control), cultural services which includes recreational benefits, and supporting services like nutrient cycling and carbon storage that maintain the conditions for life on Earth” (Cadman et al, 2010: 41).

Despite the best possible efforts to the contrary, agriculture can impact severely on the environment due to either the excess use of ecological capital and/or acting as a catchment mechanism for pollution. As these impacts often only become visible over time, are normally not reflected in market prices or any accounting system, and are mostly difficult to trace to the source, they are called negative externalities (Pretty, 2008:453).

Many of these negative externalities have only been identified, documented and costed fairly recently as they were effectively masked by the success of modern agricultural systems. A prime example of such negative externalities is the additional

cost of \$1.4 billion added per annum to the health care system through the use of pesticide in rice growing systems in China (Norse, 2001:86).

Ecological capital for agro-ecosystems can be improved through a wide variety of multifunctional resource-conserving technologies and practices but as modern agricultural systems are normally weak in resilience, the focus must be on constructs and functions that will improve the overall resilience of the greater natural system. This usually dictates that rehabilitation and/or the management of natural resources must be conducted on a landscape or bioregional level (Pretty, 2008:454).

The ways and means to facilitate the implementation of more sustainable agricultural systems on field and farm level have effectively been tested and recorded in the past ten to fifteen years. The concept of the healthy interaction between the five renewable assets of ecological, social, financial, intellectual and human capital and the resulting increase in agricultural production as well as the flow of environmental goods and services have been proven and widely accepted according to Pretty (2008:460) as well as Gbetibouo (2009:24), Smit (2002:96) and Twyman (2007:319).

Both Baudry *et al* (2000:122) and Hassan *et al* (2005:780) indicated that the constructive consequences of these sustainability interventions must be multiplied over several farms to reach the spatial tipping point where water and nutrient cycling as well as energy fluxes take place in order to improve environmental sustainability and long-term productivity through complementary and coordinated farm- and landscape-scale interventions.

To optimise these interventions cognisance must be taken of the interactive and balancing role that ecological spatial zonation needs to play in order to ensure the preservation of natural habitat and agricultural sustainability on the long term (Méndez, et al., 2013:11).

To further enhance these opportunities that provide critical provisioning, regulating, cultural and supporting ecosystem services which will impact constructively on weed, pest and disease management as well as the environmental sustainability of agricultural practices, these landscape-scale interventions must be replicated on

district or regional level to optimise the sustainability and long-term productivity of the region (Wezel, *et al*, 2013:8) and (The World Bank, 2010:84).

These regional interventions will be enhanced by the fact that the increased diversity of species and agricultural practices will be able to interact in a natural way to provide the best possible outcomes in terms of the most critical ecosystem services needed for long term resilience and sustainability (Méndez, *et al*, 2013:11).

According to Mbow *et al* (2014:247) these benefits unfortunately only accrue on field and farm level due to a lack of appropriate integration on landscape and regional level, thereby largely negating the constructive effects of all the applicable sustainability field and farm interventions. This instinctively leads to the following questions:

- How can the appropriate integration of all sustainability interventions be done on landscape and regional level?
- How will these sustainability interventions compare financially with the conventional practices?
- Which barriers will prevent or delay the migration to sustainable agricultural practices by the landowners in the Marico Biosphere Reserve (MBR)?
- Which keystones do the landowners envisage for the intensifying of sustainable agricultural practices in the Marico Biosphere Reserve (MBR)?

1.3 The research objectives

1.3.1 Primary objective

The aim of this research is *to devise a sustainable multi-level agricultural management framework for a biosphere reserve that will multiply the resilience and sustainability innovation of individual interventions.*

1.3.2 Secondary objectives

- To compare the financial feasibility of sustainable agricultural practices with that of conventional agricultural systems within the Marico Biosphere Reserve.

- To identify and overcome the barriers that prevents or delay landowners in the Marico Biosphere Reserve (MBR) from migrating to more sustainable agricultural practices.
- To conclude what the landowners envisage as the keystones for the greater uptake of sustainable agricultural practices.
- To make recommendations as to the viable avenues for further research on ways to encourage landowners to more readily adopt and persevere in the use of sustainable agricultural processes.

1.3.3 A sustainable agri-management framework for the MBR: Article 1

The objectives of the study are:

- To verify the aim of the Sustainable Agricultural Management Framework (SAMF) for the biosphere reserve.
- To align the essence and functions of the biosphere reserve concept with the aim of the Sustainable Agricultural Management Framework (SAMF).
- To formulate a set of guiding principles for the Sustainable Agricultural Management Framework (SAMF).
- To devise a set of coherent actions on each of the management levels.

1.3.4 Feasibility of the SAMF for the MBR: Article 2.

The objectives of the article are:

- To compare the financial feasibility of sustainable agricultural practices with that of conventional agricultural systems within the MBR.
- To identify the barriers that prevents or delays the landowners in the region from migrating to sustainable agricultural practices.
- To conclude the keystones that the landowners envisage for the intensifying of sustainable agricultural practices.

1.4 Scope of the research

1.4.1 Field of research

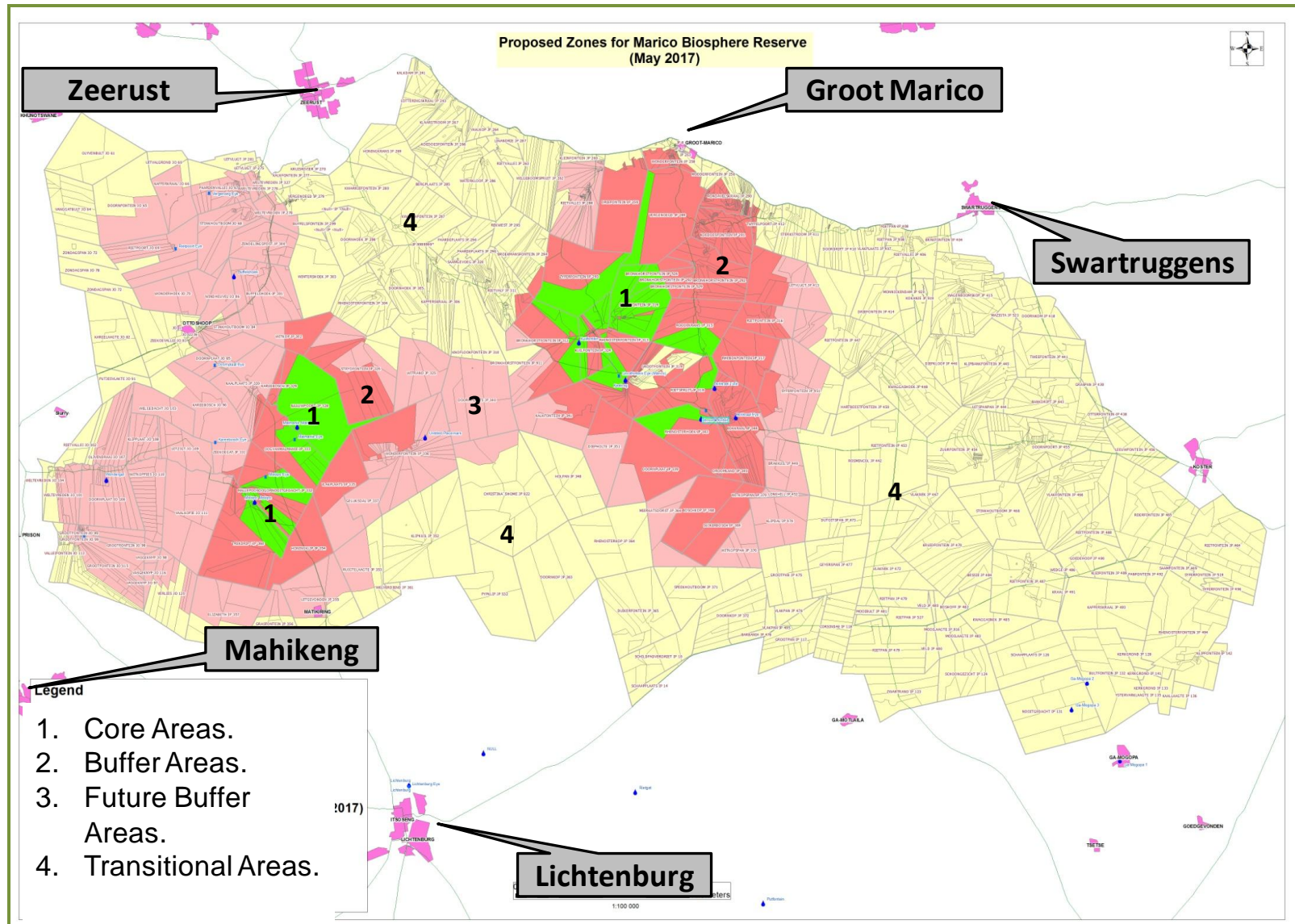
This research deals primarily with the challenges of reconciling the conservation of biodiversity with its sustainable use during agricultural production from a business point of view.

Given this strategic point of departure the research involves five of the six capitals as identified by the International Integrated Reporting Framework (2013:11) in order to determine how the interaction between these five renewable capitals (ecological, social, financial, intellectual and human) may be utilised to create integrated value for all stakeholders.

The needed global increases in agricultural production as well as the flow of environmental goods and services shape the broad structure in which this research is conducted.

1.4.2 Geographical Demarcation

In order to anchor the research to a specific bioregion, the proposed Marico Biosphere Reserve which encompasses 447 268 ha in the North West Province of South Africa (Map 1) has been selected as the study area.



Map 1: The location of the proposed MBR.

1.5 Research Methodology

1.5.1 Literature Study

Firstly, a literature study will be conducted to obtain clarity about the plethora of definitions and concepts dealing with sustainable agriculture, agro-ecology, conservation agriculture, silviculture, ecosystem services, and biodiversity, ecological or ecological and human as well as social and intellectual capital.

Secondly, the literature dealing with the aforementioned concepts will be studied to ascertain the context and magnitude of the challenges facing the present-day agricultural community. This will enable the researcher to thirdly determine what the aim of the SAMF must be and on what different management levels this framework must be operationalised.

The aforementioned aim and management levels will then be hitched to the essence and functions of a biosphere reserve which will fourthly lead to the formulation of guiding principles for the SAMF.

Fifthly, the literature will be studied to devise a set of coherent actions on each of the management levels.

Different methods to compare the financial feasibility of sustainable agricultural practices with that of conventional agricultural systems will then be utilised.

Lastly previous studies will be used to gain insights into the possible barriers to the greater uptake of sustainable agricultural practices. These studies will assist in the compilation and interpretation of the survey that will be utilised to determine the mind-set of the target group and the way forward within the SAMF.

1.5.2. Research Approach

The complexity of the aforementioned subjects makes finding conclusive results difficult, therefore more than one tool will be utilised to unlock the answers to the research questions. This necessitates both a qualitative and quantitative approach to devise a SAMF; thereafter quantitative methods will be used to determine the

financial feasibility of the specific sustainable agricultural practices within this agricultural management framework.

Thirdly both quantitative and qualitative methods will be utilised to gain insights into the possible barriers to and potential keystones for the greater uptake of sustainable agricultural practices by the target group.

The completion of the survey by a representative sample of the target population will be followed by a number of interviews with some of the agricultural leaders within the study sample.

1.5.2.1 Construction of the Survey

The survey will be informed by previous studies done, the literature review of the sustainability constructs and the creation of the SAMF as such. It will first be tested with a small sample of the target group whereafter it will be revised and send to the target group by utilising SurveyMonkey.com.

1.5.2.2 Study population, sample and data collection

The study population consisted of the 186 landowners in the different buffer zones of the Marico Biosphere Reserve. In order to obtain at least a workable sample, all persons within the study population were targeted by means of an electronic survey conducted via Survey Monkey.

After the analysis of the responses and the interpretation thereof, interviews will be done with 6 persons from the management teams of the four agricultural associations in the MBR to deliberate on the results obtained and refine the actions to be taken to enhance the uptake of sustainable agricultural practices in the MBR region.

1.6 Limitations of the Study

“Where does scientific knowledge come from? A good scientist pushes to the edge of knowledge and then reach beyond, forming a conjecture – a hypothesis- about how things work in that unknown territory. In the same way, a good business strategy deals with the edge between the known and the unknown. A good strategy is, in the

end, a hypothesis about what will work. Not a wild theory, but an educated judgement” (Rumelt, 2012:243).

As the aim of this research is *to devise a sustainable multi-level agricultural management framework for a biosphere reserve that will multiply the resilience and sustainability innovation of individual interventions*, the implementation, evaluation and adaptation of this framework over time fall outside the scope of this study and will therefor form the second ongoing component of this study.

Given the extent of the research questions that had to be answered it is clear that

- the search for innovative alternatives for funding to ensure a bigger uptake of Sustainable Agricultural Practices as well as
- the impact of the sustainable multi-level agricultural management framework for a biosphere reserve on the value of the land

also falls outside the parameters of this research and will have to constitute a third and fourth component of further research.

1.7 Layout of the Study

Chapter 1: Introduction to sustainable agriculture.

This chapter covers the background to the study, the problem statement, the research objectives, scope of the research, the research methodology and the limitations of the research as well as the layout of the study.

Chapter 2: Sustainable agricultural in practice.

Chapter 2 encompasses the review of the subjects as listed below:

- The plethora of definitions and concepts dealing with sustainable agriculture, agro-ecology, conservation agriculture, silviculture, ecosystem services, biodiversity, ecological or ecological and human as well as social, financial and intellectual capital.
- The context and magnitude of the challenges facing the present-day agricultural community.
- The outcomes of sustainable agricultural practices on the abovementioned challenges.

Chapter 3: A Sustainable Agricultural Management Framework: Article 1.

In this article the SAMF is constructed according to the following structure:

- The introduction which deals with the problem statement, research objectives and research methodology.
- Related literature review.
- Results.
- Conclusion and recommendations.

Chapter 4: Implementation of the SAMF: Article 2.

The viability of the devised SAMF is assessed within the following outline:

- The introduction which deals with the problem statement, research objectives and research methodology.
- Related literature review.
- Results.
- Conclusion and recommendations.

Chapter 5: Conclusion and recommendations.

This chapter deals with the following:

- Conclusion.
- Recommendations.
- Annexure A: List of References.
- Annexure B: Questionnaire.
- Annexure C: Financial data utilised.

CHAPTER 2: SUSTAINABLE AGRICULTURAL IN PRACTICE

2.1 Introduction

The literature study was firstly conducted to obtain clarity about the plethora of definitions and concepts dealing with sustainable agriculture, agro-ecology, conservation agriculture, silviculture, ecosystem services, biodiversity, ecological or ecological and human as well as social and intellectual capital.

Secondly the context and magnitude of the challenges facing the present-day agriculturalist was ascertained to create a conceptual structure for developing and testing the SAMF.

2.2 Definitions and Concepts

2.2.1 Integrated value, the different capitals and sustainability

As integrated value is seen as the result of combining integrated thinking and integrated action, the International Integrated Reporting Council (IIRC) devised six interdependent categories of assets, labelled capitals by the Council, to ease the amalgamation of all available resources into the planning, organising, coordination and control of all business processes.

This framework improves the probability of delivering authentic integrated value to the customer, all stakeholders and society at large (The International IR Framework, 2013:10).

Even if this classification of the capitals, as envisaged by the IIRC is maybe not unerringly appropriate to all circumstances, it functions as an effective roadmap towards delivering authentic integrated value in the business world (The International IR Framework, 2013:10).

The International Integrated Reporting Council defines these capitals as: (The International IR Framework, 2013:11)

- financial capital which describes the finances accumulated in the course of all legal business processes with the aim of funding production and/or services;
- manufactured capital which consists of those material goods that are considered as assets when the accounting processes are employed;
- intellectual capital which is the sum of all operational systems and procedures, expertise in the firm and intellectual property;
- human capital which is depicted as the way of thinking, the inspiration and values as well as the competence of the people within the organisation that is utilised to execute the firm's strategy;
- social and relationship capital which is formed through the bond between the firm, all people with a legitimate interest in the firm's activities and the general public;
- ecological capital which is the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.

As each farm is a business unit, business sustainability needs to be established first. Dyllick and Hockerts (2002:131) define business sustainability as meeting the needs of current stakeholders in such a way that the need of potential stakeholders can be equally well met in future. To this end, businesses must zealously grow their economic, social and ecological capital as well.

Crane and Matten (2010:34) maintain from a business ethics viewpoint that business sustainability refers to the long-term maintenance of systems in such a way that its economic, social and ecological capital is enhanced over time.

These aforementioned definitions imply the following three key elements of business sustainability: (Crane and Matten, 2010:34)

- the integration of the economic, social and natural dimensions of business sustainability into a "triple bottom line" as these three aspects are interdependent;
- reprioritising the short and long-term viewpoints of the corporation to counter the precedence of short term gain on the balance sheet over the

longer term, less impressive prevention of social and/or ecological capital degradation through unacceptable business practices and

- consumption of the income rather than the capital – this business principle must also be applied vigorously to the social and ecological capital as well and not only to the economic capital.

Against the backdrop of these three key elements of business sustainability, Dyllick and Hockerts (2002:133) further classify an economically sustainable entity as a corporation that ensure a positive cash flow while consistently producing an above average return to its shareholders.

Together with this, Dyllick and Hockerts (2002:134) argue that the sustainable corporation only consumes ecological resources at a rate lower than natural reproduction of these resources.

It also maintains its ecological footprint at a level lower than the capacity of the natural system to absorb it while it does not engage in activities that degrades biodiversity and eco-system services (Dyllick and Hockerts, 2002:134).

Dyllick and Hockerts (2002:135) further state that the socially sustainable corporation adds value by increasing the human and societal capital of these communities over time and to optimise this, the corporation must also abide by a set of values that the target population can identify with.

2.2.2 General and Ecological Definitions

The following general and ecological definitions were explored to assist with the development of a conceptual structure for the SAMF:

	Concept	Definition and source(s)
1.	Framework	“Broad overview, outline, or skeleton of interlinked items which support a particular approach to a specific objective and serves as a guide that can be modified as required by adding or deleting items” (Business dictionary, 2017).
2.	Keystone	“A central stone at the summit of an arch, locking the whole together. The central principle or part of a policy, system, etc., on which all else depends” (Oxford Dictionary, 2017).

	Concept	Definition and source(s)
3.	Resilience	“Ability of a material to resume its original size and shape after a deformation or the ability of a system to absorb the impact of the failure of one or more components or a significant disturbance in its environment and to continue to provide an acceptable level of service” (Business dictionary, 2017).
4.	Stewardship	“The job of taking care of something, such as an organization or property” (Oxford Dictionary, 2017).
5.	Strategic-Inflection-Point	“The time of transition of a company's competitive position that requires the company to change the current path and adapt to the new situation or risk declining profits” (Business dictionary, 2017).

Table 1.1: General Concepts

These ecological concepts and definitions are quoted verbatim from the different sources to ensure clarity in the discussions that follow. The primary source used is Cadman et al, 2010, who compiled the “*Biodiversity for Development: South Africa's landscape approach to conserving biodiversity and promoting ecosystem resilience*” which forms the national guideline in terms of conservation terminology.

	Ecological Concept	Definition and source(s)
1.	Allelopathic	“Allelopathy is a biological phenomenon by which an organism produces one or more bio-chemicals that influence the germination, growth, survival, and reproduction of other organisms” (Oxford Dictionary, 2017).
2.	Biodiversity	“The diversity of genes, species and ecosystems on Earth, and the ecological and evolutionary processes that maintain this diversity” (Cadman et al, 2010:83).
3.	Biodiversity corridor	“Landscape structures of various size, shape and habitat composition that maintain, establish or re-establish natural landscape connectivity. They can have a continuous or interrupted structure or a structure of stepping stones” (READ, 2015:83).

	Ecological Concept	Definition and source(s)
4.	Biodiversity stewardship Programme	“To reach the national protected area targets, the Department of Environmental Affairs devised the Biodiversity Stewardship Program that enables private and communal landowners to obtain legal protection for their land with high biodiversity value. This is done through a legally binding contract between the National or Provincial conservation authorities and the landowner. The latter can decide upon one of the three available categories of protection (nature reserve, protected environment or conservancy). Each category provides a specific level of protection for the land and corresponding benefits for the owner. The ownership of the land and the key accountability for the management thereof does not change. The conservation authorities provide certain benefits, depending on the category to the owner” (Department of Environmental Affairs, 2013:4).
5.	Biodiversity threshold.	“The smallest fraction of an ecosystem type that has to be maintained at a natural or near-natural condition in order to ensure that the greater part of species connected with these ecosystem types as well as meaningful samples of all ecosystem types remain viable over time” (Cadman et al, 2010:83).
6.	Carbon sequestration	“A biochemical process through which atmospheric carbon is absorbed and stored by living organisms including plants and soil micro-organisms, involving the storage of carbon in soils, with potential to reduce atmospheric carbon dioxide levels” (Cadman et al, 2010:83).
7.	Climate Change	“The most general definition of <i>climate change</i> is a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause. Accordingly, fluctuations over periods shorter than a few decades, such as El Niño, do not represent climate change” (Business dictionary, 2017)
8.	Climate change adaptation	“Initiatives and measures to reduce the vulnerability of natural and human systems to the actual or expected impacts of climate change” (Cadman et al, 2010:84).
9.	Climate change mitigation	“Measures to reduce greenhouse gas emissions into the atmosphere and enhance greenhouse gas sinks” (Cadman et al, 2010:84).
10.	Critical Biodiversity Areas (Critical Biodiversity Area’s)	“Terrestrial and aquatic areas of such conservation value that their presence in a landscape will automatically ensure the maintaining of the biodiversity threshold if they are sufficiently protected” (READ, 2015:84).
11.	Ecological	“Relating to or concerned with the relation of living organisms to one another and to their physical surroundings” (Natural Capital Coalition, 2017).

	Ecological Concept	Definition and source(s)
12.	Ecological infrastructure	“Naturally functioning ecosystems that deliver valuable services to people. Ecological infrastructure need not be in a good ecological condition but should retain at least some of its natural ecological functioning. One piece of ecological infrastructure may deliver several ecosystem services, for example karst landscapes or wetlands” (READ, 2015:84).
13.	Ecological processes	“The functions and processes that operate to maintain and generate biodiversity. It includes those actions and interactions which enable natural systems to function and run as healthy, working systems” (READ, 2015:84).
14.	Ecological Support Areas	“Terrestrial and aquatic zones on landscape level that assist with the delivering of ecosystem services and/or support the ecological performance of one or more Critical Biodiversity Area(s)” (READ, 2015:84).
15.	Ecosystem services	“The benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control), cultural services (such as recreational and spiritual benefits), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth. Ecosystem services are the flows of ecological value to human society that result from a healthy stock of ecological infrastructure. If ecological infrastructure is degraded or lost, the flow of ecosystem services will diminish” (Cadman et al, 2010:85).
16.	Landscape	“A portion of land or territory which the eye can comprehend in a single view, including all the objects it contains” (Wiktionary, 2017).
17.	Living landscape	“The conservation science definition of a ‘living landscape’ is that which has a variety of healthy ecosystems and land uses and is home to ecological, agricultural and social systems which are managed so that they function sustainably” (READ, 2015:86).
18.	Ecological Capital	“Ecological capital is the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people. The benefits provided by ecological capital include clean air, food, water, energy, shelter, medicine, and the raw materials used in the creation of products. It also provides benefits such as flood defence, climate regulation, pollination and recreation. Ecological capital supports all of the other capitals by providing essential resources that support a healthy planet and underpins thriving societies and prosperous economies” (Natural Capital Coalition, 2017).
19.	Protected area:	“A terrestrial or maritime area that, due to its conservation and biodiversity value, enjoys legal protection” (READ, 2015:86).

Table 1.2: General and Ecological definitions

2.2.3 Sustainable Agricultural Practices Delineated

The dire need to address ecological degradation has generated many diverse concepts and ideas which are all vigorously pursued by assorted individuals and organisations on various field and farm levels. In order to obtain clarity about the usefulness and value of these constructs, they were listed in the table below and the recurring ideas formatted in italics:

	Concept	Definition and source
1.	Agro Forestry	The Association for Temperate Agroforestry defines agroforestry as an intensive land management system that optimizes the benefits from the <i>biological interactions</i> created when trees and/or shrubs are deliberately combined with crops and/or livestock (Association for Temperate Agroforestry, 2017).
2.	Silviculture	Silvicultural systems are designed to ensure sustainable forest management, which is defined formally as the stewardship and use of forests and forest lands in a way, and <i>at a rate</i> , that maintains their <i>biodiversity, productivity, regeneration capacity, vitality</i> and their potential to fulfil, now and in the future, relevant <i>ecological, economic and social functions</i> , at local, national, and global levels, and that does not cause damage to other ecosystems (Forest Europe, 2017).
3.	Conservation Agriculture	Conservation agriculture has been proposed as a potential system for improving <i>soil quality and providing stable yields through minimum soil disturbance, surface crop residue retention (mulching) and crop rotations</i> or associations (Thierfelder, et al., 2013:248).
4.	Climate Smart Agriculture	Climate-smart agriculture is an approach for transforming and reorienting agricultural systems to <i>support food security</i> under the new realities of climate change (Lipper, et al., 2014:1068).
5.	Agro-ecology	Agro-ecological systems are configured by incorporating <i>ecosystem services and ecological processes as primary components</i> of such a system. Within these systems, the utilisation of chemicals as fertiliser or herbicides is exchanged for <i>natural solutions</i> to these challenges. <i>Soil quality</i> is enhanced, and <i>water conservation</i> implemented through <i>biological measures</i> . <i>Biodiversity preservation</i> and <i>carbon sequestration</i> also form integral components of these systems while genetic modification is not used in the quest to optimise the yield of these systems (Wezel, et al., 2013:15).
6.	Wildlife Friendly Farming	These practices are aimed at reducing the negative impacts of intensive agriculture by implementing <i>conservation actions in farmed landscapes</i> to conserve and restore biodiversity (Pywell, et al., 2015:244).
7.	Pastoral livestock production	Pastoral livestock production makes extensive <i>use of ecosystem services</i> and eliminates many of the problems of confinement or intensive production techniques (Tilman, et al., 2002:674).

	Concept	Definition and source
8.	Sustainable Agricultural Practices	Sustainable agriculture is defined as practices that meets current and future societal needs for food and fibre, for <i>ecosystem services</i> , and for healthy lives, and do so by maximizing the net benefit to society when all <i>costs and benefits</i> of the practices are considered. (Tilman, et al., 2002:671)

Table 1.3: Sustainable Agricultural Practices

From the abovementioned it is clear that the different concepts and ideas share the *integration of ecological resources, processes and ecosystem services as primary components of these systems*. Within these sustainable systems, the utilisation of chemicals as fertiliser or herbicides is exchanged for *natural solutions* (Own Source).

Soil quality is enhanced and *water conservation* implemented through *biological measures*. *Biodiversity preservation* and *carbon sequestration* also form integral components of these systems while genetic modification is not used in the quest to optimise the yield of these systems because they strive towards maintaining and increasing the ecological capital of the area (Own Source).

According to Rodriguez et al (2008:61), “most proponents of the concept will *however* agree that sustainable agriculture is not a defined set of agricultural practices, but rather a dynamic condition, a long-term goal” that will only be reached after a long journey. A mix of practices tailored to reach relevant objectives in a given area will give a higher return on investment than the use of any single concept on its own.

2.2.4 Sustainable agricultural practices defined

For the purpose of this study, sustainable agricultural practices are thus defined as those agricultural systems that integrate the ecological resources, processes and ecosystem services as primary components of these systems on all relevant management levels in order to at least maintain or preferably increase the ecological capital (Own Source).

As the aforementioned practices focus on the ecological resources, processes and ecosystem services, the phrase “ecological capital” is preferred for this study rather than the more frequently used “natural capital” as the former denotes the current situation while the latter will rather be utilised to illustrate the more original state of the environment before mankind started to transform it (Own Source).

Ecological capital for agro-ecosystems can be improved through a wide variety of multifunctional resource-conserving technologies and practices but as modern agricultural systems are normally weak in resilience, the focus must be on constructs and functions that will improve the overall resilience of the greater natural system. This usually dictates that rehabilitation and/or the management of natural resources must be conducted on a landscape or bioregional level (Pretty, 2008:454).

Given the complex composition of the abovementioned ecological capital, it is exceptionally challenging to determine the tipping point where any one of the specific ecological resources and/or processes will reach its site-specific threshold, which once crossed, makes the system normally cave in completely (Dodds, 1997:21).

To mitigate this challenge, the concept of resilience will be utilised as the collective construct to denote the combined health and threshold of the numerous ecological resources, processes and ecosystem services that institute the abovementioned ecological capital (Own Source).

Resilience thus forms the keystone for the concept of sustainable agricultural practices and will be the measuring unit to determine the latitude remaining between the current reality and the ecological inflection point (Own Source).

2.2.5 Characteristics of sustainable agricultural systems

“Sustainable Agriculture Practices” strives to optimise the utilisation of ecological resources, processes and ecosystem services while at the same time not damaging these assets (Pretty, 2008:451). According to Pretty sustainable

agricultural practices thus rests on the following principles to accumulate eco-profit:

- The integration of ecological resources processes and ecosystem services into sustainable agri-practices. Although not limited to, it will at least include the use of natural solutions for fertilisation and pest control as well as biological measures to enhance soil quality and water conservation.
- If non-renewable inputs have to be incorporated into a sustainable system, they are kept to the absolute minimum.
- Through optimising the mind-set, knowledge, skills and self-reliance of farmers the available human, financial, intellectual and social capital of the industry are enhanced and the utilisation of costly inputs from outside the farm borders minimised.
- Aligning the collective competence of relevant people to address the challenges experienced during the management of natural resources and the other assets involved in agricultural production.

Maximising the return and minimising the risk of sustainable agricultural practices dictates the innovative application of the above-mentioned principles combined with the optimum application of human capital in the form of leadership, ingenuity and management skills (Pretty, 2008:452).

This concept must then be supported by ground-breaking configurations of capital and organisations that will enable imaginative lateral and vertical partnerships to create sustainable multifunctional agricultural systems based on the utilisation of ecological resources, processes and ecosystem services as well as the optimisation of agri-technologies and techniques for local conditions (Pretty, 2008:451).

The focus is consequently on sustainable practices that utilises the available ecological, social, human, intellectual and financial capitals to merge the best area specific genotypes and finest ecological management into a whole that optimises returns and restrict or eliminate harm to the environment (Pretty, 2008:451).

To prevent a checkmate position, sustainable agricultural practices must equal or better the yield of the comparable agricultural system to avert an increase in land needed to offset the expected lower yield from sustainable agricultural practices (Pretty, 2008:455).

In spite of the fact that this is indeed a mammoth task in the highly industrialised agricultural systems of the developed countries, at least 3 million hectares in Europe were converted to certified organic agri-systems, thereby impacting positively on the future sustainability of the region (Pretty, 2008:455).

In developing countries, where the mean production is lower, a study comprising 286 sustainable projects in 56 countries, sustainable agricultural practices returned a mean relative yield increase of 79% across an extremely broad range of systems and crop types. Even if the geometric mean is used to iron out the experienced positive skew, the yield still increased by 64% (Pretty, 2008:456).

According to comparative studies, these yield increases were accompanied by definite and easily discernible profits in terms of the available ecological, social, human and financial assets of the regions (Pretty, 2008:456).

Linked to the increase in sustainable agricultural practices yields, the implementation of Integrated Pest Management initiatives in 26 industrialised and developing countries, covering 25.3 million hectares farmed by more than five million farmers, consistently returned at least a 60% success rate in terms of yield increases complemented by a sizeable decrease in pesticide use (Pretty, 2008:458).

Lastly Lal (2008:821) defines carbon sequestration as “the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere”.

Although agriculture is known to be an emitter of carbon, sustainable agricultural practices as a system can also accumulate carbon, thereby creating the possibility

of utilising the trading of carbon credits to augment farming income as a study incorporating 286 sustainable agricultural practices projects indicated substantial carbon sequestration opportunities (Pretty, 2006:1116).

2.3 Ecological Profit

Within the financial realm profit, as the most indicative test for success in a business endeavour, is defined as the “surplus funds remaining after total costs are deducted from total revenue and it is the basis on which dividends are paid” (Business dictionary, 2017).

Profit is realised through a decrease in liabilities, an increase in assets and/or growth in owners' equity. It provides resources for investing in future ventures, and its absence normally leads to the termination of the endeavour (Business dictionary, 2017).

If these financial parameters are transposed into environmental terminology, ecological *profit* will accrue through a reduction of negative externalities and the sustainable utilisation of natural resources (*liabilities*) (Pretty, 2008:453)

This will be accompanied by an increase in the biodiversity and ecosystem services (*assets*) that will lead to greater environmental resilience and the accompanying growth in ecological capital (*owners' equity*) (Own Source).

Diligent accrual of ecological profit (eco-profit) will therefore provide resources for investing in future ventures while a lack of ecological profit (eco-profit) will lead to the termination of the human endeavours over time after overstepping the aforementioned ecological inflection point (Own Source).

2.4 The challenges facing the present-day agriculturalist

There are two directly opposing driving forces at play around the aforementioned ecological inflection point. On the one hand are the negative drivers (see table 1.4) that are perpetually propelling the planet to the point where the keystone of resilience will exceed its threshold and thereby perpetuate an irreversible ecological collapse (Own Source).

Resisting these negative drivers are the constructive ecological forces of the living planet as indicated in figure 2, trying to slow down, stop and reverse the abovementioned advance towards the ecological inflection point (Own Source).

From the literature the major negative drivers have been identified as human needs and wants, human omissions, climate change and intrinsic factors over which mankind has no direct control. These key influences towards an irreversible ecological collapse may be described as follows: (Own Source)

	Driver	Description	Consequences
1.	Human needs & wants	<ul style="list-style-type: none"> a. Need more and more prime land for producing food as the global population grows. b. Intensive livestock production increases to meet the expanding demand for animal protein as the income of people in developing countries grows. c. The increasing use of fossil fuels increases greenhouse gas emissions. 	<ul style="list-style-type: none"> a. Biodiversity loss. b. Decrease of soil potential. c. Decline of food security and human health. d. Pollution. e. Ecological degradation. f. Decline in the regeneration capacity of ecological systems. g. Decrease in ecosystem services. a. Increase in pest and disease epidemics.
2.	Human Omissions	<ul style="list-style-type: none"> a. Lack of integration during the conservation of ecological resources, processes and ecosystem services. b. Isolation of protected areas and the fragmentation of ecological processes and ecosystem services. c. Ecological degradation due to not integrating ecological and human spatial planning. d. Lack of trust, integration of effort and cooperation on landscape and bioregional levels. 	<ul style="list-style-type: none"> a. Piecemeal efforts don't optimise the functions of ecological processes and ecosystem services. b. Patch work protected areas negate the benefits of ecological, processes and ecosystem services. c. Human spatial planning and development is carried out without consideration for the ecological capital. d. Most constructive actions are only carried out on field and farm level.

	Driver	Description	Consequences
3.	Climate Change	<ul style="list-style-type: none"> a. Use of fossil fuels. b. Accumulation of water vapour, carbon dioxide, methane, nitrous oxides, and chlorofluorocarbons in the atmosphere through conventional industrial and agricultural practices. 	<ul style="list-style-type: none"> a. Declining crop yields in certain traditionally rain fed areas. b. Habitat loss and fragmentation of ecological resources, processes and ecosystem services. c. Extinction of species on micro level. d. Water stress in numerous areas.
4.	Intrinsic Factors	<ul style="list-style-type: none"> a. The slow speed of biological regenerating processes. b. The cost for maintenance of ecological resilience must be paid upfront while the benefits mainly accrue to probably unknown people sometime in the future. c. The transition and opportunity cost of migrating to more sustainable agricultural and business practices. d. The complex characteristics of ecological resources, processes and ecosystem services. e. The limited ecological resources like water, land and nutrients. 	<ul style="list-style-type: none"> a. The downward spiral of ecological capital is much quicker than the regeneration tempo of nature. b. People do not care enough to get involved. c. Water and land are not infinite while the population numbers are forever increasing.

Table 1.4: The major negative drivers to an irreversible ecological collapse

According to the Global Footprint Network (2012) and Ehrlich & Ehrlich's (2012:1) analysis' the human race currently exceeds the long-term carrying capacity of our planet by almost 50 percent.

To continue supporting today's global population at the current standards of living in a sustainable way, we will need approximately half an extra planet's ecological capital while alleviating all people on earth to the living standard of the USA will require four to five more planets (Ehrlich & Ehrlich's, 2012:1).

The fact that the constructive ecological forces of the living planet will not be able to slow down, stop or reverse the impacts of the negative drivers on its own is proven Ehrlich & Ehrlich’s (2012:2).

To apprehend the downward spiral towards the ecological inflection point, mankind will have to step up its efforts to implement sustainable agricultural systems to assist the existing ecological resources, processes and ecosystem services through result driven ecological innovation (Own Source).

To realise this result driven ecological innovation, “business as usual” will have to be rapidly substituted with an integrated multi-dimensional effort to bring all possible human, social, intellectual and financial capital to bear on designing and implementing sustainable agricultural systems. For this, there is profound need for a SAMF (Own Source).

By way of a summary, the challenges facing the present-day agriculturalist can be graphically presented as follows by an adapted force field analysis: (Own Source)

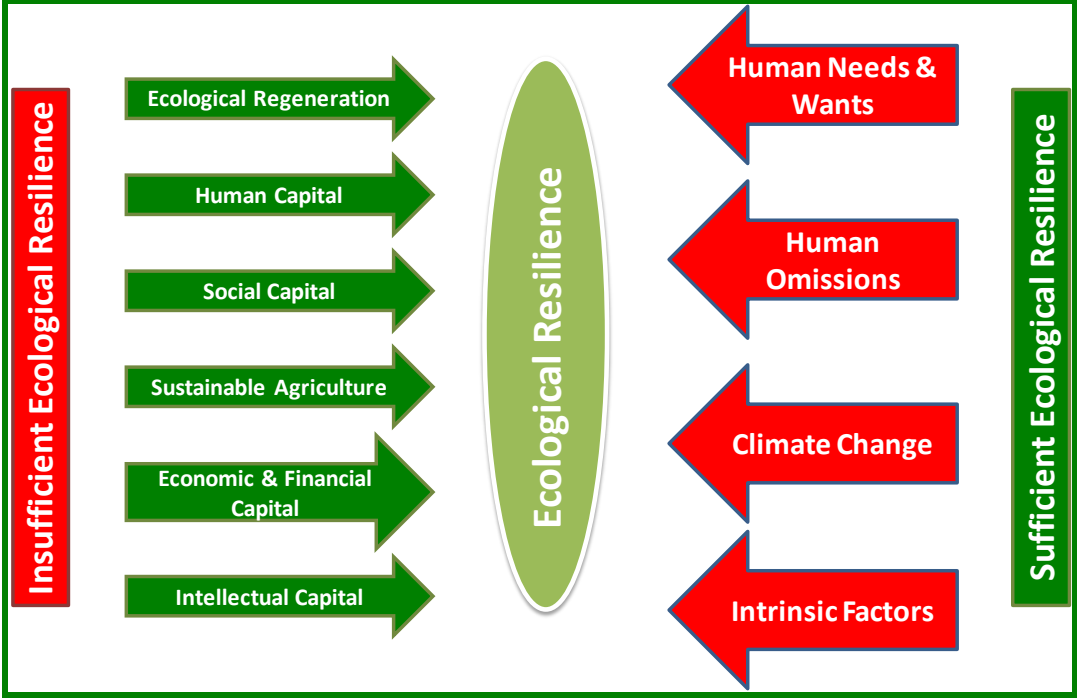


Figure 1: The negative and positive forces impacting on ecological resilience.

To at least maintain the current ecological resilience the agriculture industry will have to plan, organise, coordinate and control the employment of the constructive drivers extremely carefully (Own Source).

Increasing the current ecological resilience will need even greater commitment of human, social, intellectual and financial capital. These imperatives dictate a strategic approach of “ecological profit (eco-profit) accrual over time on all applicable management levels” as the mantra of the future (Own Source).

2.5 Conclusion

The abovementioned synopsis indicates that a strategic approach of “eco-profit accrual over time on all applicable management levels” can definitely be rewarding and sustainable if the other possible barriers of transition and opportunity costs due to capital investments needed, the time it takes for the biological processes to renew the ecological capital and the time spent on learning new skills and technologies can be bridged (Kesavan, 2008:41).

To step up its efforts to implement sustainable agricultural systems to assist the existing ecological resources, processes and ecosystem services through result driven ecological innovation, mankind needs a skeleton of interlinked objectives and actions which support the drive to optimise the abovementioned ecological capital gains through replicating it on landscape and regional level.

CHAPTER 3: A SUSTAINABLE AGRICULTURAL MANAGEMENT FRAMEWORK: ARTICLE 1.

3.1 Introduction

From the literature the essence and functions of a biosphere reserve were firstly determined. Subsequently the fundamental character of strategy was briefly touched upon to create a construct for assembling the SAMF.

Thirdly the aim of the SAMF was considered, whereafter the guiding principles for this structure were resolved. Lastly the combination of these preceding features led to the formulation of a set of coherent actions on each of the management levels to bulk up the skeleton of said framework.

3.1.1 Problem statement

The ways and means to facilitate the implementation of more sustainable agricultural systems on field and farm level have effectively been tested and recorded in the past ten to fifteen years.

Both Baudry et al (2000:122) and Hassan et al (2005:780) indicated that the constructive consequences of these sustainability interventions must be multiplied over several farms to reach the spatial tipping point where water and nutrient cycling as well as energy fluxes take place as this will improve the ecological sustainability and long-term productivity through complementary and coordinated farm- and landscape-scale interventions.

As there is currently no framework to coordinate and multiply the constructive consequences of these sustainability interventions during landscape-scale interventions, the problem has been stated in chapter 1 as “How can the appropriate integration of all sustainability interventions be done on landscape and regional level?”

From the diagnosis in the previous chapters that identified the challenges facing the present day agriculturalist as “to realise this result driven ecological innovation, *business as usual* will have to be rapidly substituted with an integrated multi-

dimensional effort to brought all possible human, social, intellectual and financial capital to bear on designing and implementing sustainable agricultural systems, the aim of the SAMF was synthesised as follows:

“To create integrated value for the region, its people and society at large through the implementation and maintenance of integrated multi-dimensional sustainable agricultural systems” for the MBR.

In order to reach the aforementioned aim, these integrated multi-dimensional sustainable agricultural systems must contribute towards the attainment of the following goals: (Own Source)

- The accumulation of ecological profit through protecting and improving the current ecological resilience and capital.
- The enhancement of the human, social and intellectual capital of the region so as to realise result-driven ecological innovation.
- The counteraction of the precedence of short term gain on the balance sheet over the less impressive longer-term human, social, intellectual, financial and ecological profit.
- The assurance of a positive cash flow while consistently producing above averages returns.

3.1.2 Study objectives

3.1.2.1 Primary Objective:

To devise a workable strategy that will achieve the aim of the SAMF.

3.1.2.2 Secondary Objectives:

- To fuse the essence and functions of the biosphere reserve concept with the sustainable agricultural practices into the abovementioned strategy.
- To optimise the possible ecological capital gains on field and farm level by replicating it on the landscape and regional levels.

3.1.3 Study method.

A systematic literature review was linked to a Logical Framework as strategy developing tool to fulfil the study objectives.

3.2 Literature review

3.2.1 The essence and functions of a biosphere reserve

A biosphere reserve is an internationally recognised and delineated bioregion that consists of one or more areas of high conservation value that are legally protected as a nature reserve or protected environment. Such areas form the core of the biosphere reserve and are shielded by an encircling buffer zone against threats to the ecological integrity of these core area(s) (MRCA, 2017:12).

The composition of the biosphere reserve is rounded off by the transitional zone that surrounds the buffer area(s) as indicated on map 2 and in figure 3 (Programme on Man and the Biosphere, 2005:11).

The rationale behind the spatial demarcation is situated in the different purpose of each zone. Ideally, all the critical biodiversity areas will be located in the core of the biosphere reserve to optimise and legally protect the biodiversity and ecosystem services flowing from these essentially pristine land parcels (MRCA, 2017:12).

To maintain the natural resilience of these systems, the approved activities are restricted to low-impact uses like eco-tourism, recreation, environmental education, limited sustainable agriculture and research as indicated in figure 3 (MRCA, 2017:12).

The buffer zone is normally more transformed than the essentially pristine land parcels of the core area and acts primarily as ecological support area for the whole of the bioregion (MRCA, 2017:12).

To shield the ecological integrity of the core area against direct threats, the preferred activities must be of sound ecological nature, non-intrusive and may include eco-tourism, sustainable agricultural practices, recreation, research, environmental education and any other pursuit that adheres to the prescribed criteria, as indicated in figure 3 (MRCA, 2017:15).

The transitional zone serves as a shock absorber for the buffer and core areas and is usually the more transformed area of the biosphere reserve. Although the principle of eco-profit still applies, the criteria governing the activities favoured in this sector of the biosphere reserve are much less stringent than in the other two zones (MRCA, 2017:12).

It is however envisaged that the transitional zone will over time, as the land use changes due to awareness and commitment among the residents, also contribute to the maintenance and building of ecological capital as indicated in figure 3 (MRCA, 2017:16).

Due to historical land uses, it is however difficult to find a new biosphere reserve with the perfect zonation, therefore one of the reserve's management objectives is to manage the assets within the biosphere reserve in such a way that the ecological, social and economic sustainability and contribution of each zone is optimised over time. Each biosphere reserve is thus a work in progress (MRCA, 2017:12).

As indicated in figure 3, this zonation model of the biosphere reserve strongly supports both the *Land Sparing and Land Sharing* concepts simultaneously. The former dictates that the pristine areas of the region with high ecological value must be protected from all transformation through inclusion as protected areas in the Biodiversity Stewardship Program (Phalan, et al., 2011:1290).

The other areas may then be utilised for agriculture and industrial purposes, while the latter prescribes that the ecological support areas on the farms must also be preserved through the use of silviculture and agroforestry as part of the Biodiversity Stewardship Programme's conservancies to improve the current ecological resilience (Phalan, et al., 2011:1290).

The features, utilisation concept and primary land usages of the MBR's zonation can be summarised by means of table 1.5 and figure 2.2: (Own Source)

	MBR Zone/Area	Features	Utilisation Concept	Primary Land Usages
1.	Core Areas	Protected and Critical Biodiversity areas	Land Sparing. Land Sharing	a. Eco-tourism. b. Recreation. c. Limited SAP. d. Research. e. Environmental Education.
2.	Buffer Zones	Ecological Support Areas	Land Sharing	a. Eco-tourism. b. Recreation. c. Research. d. Full scale SAP. e. Environmental Education.
3.	Transitional Zones	Shock Absorber of MBR.	Land Sharing	a. Research. b. Full scale SAP. c. Industrial & Mining. d. Environmental Education.

Table 1.5: The land usages in the MBR

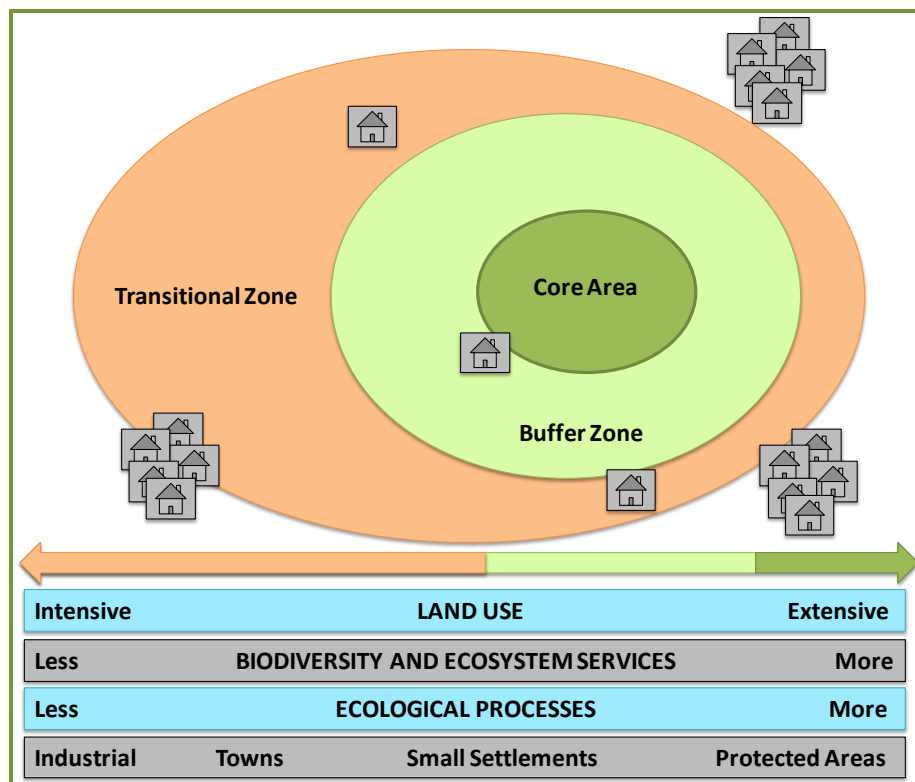


Figure 2.2: Biosphere Reserve Zonation and Land use guidelines

This approach, reinforced by the biosphere reserve's functions of conservation, sustainable economic and human development as well as research, monitoring, education and information exchange creates a distinctive structure for the implementation of long term bioregional interventions (MRCA, 2017:19).

It caters over time for the formation of a "*living landscapes*" consisting of vigorous ecosystems supported by beneficial land uses which are home to ecological, agricultural and social systems whose sustainable functioning are effectively administered on all related ecological, economic, cadastral and management levels (MRCA, 2017:19).

As seen in previous chapters, sustainable agricultural practices need such a framework to integrate the ecological gains made on field and farm level in order to replicate it on landscape and regional level.

This replication on the latter two levels will also enable the ecosystem services to reach their optimum production as long as the two concepts of living landscapes and sustainable agricultural practices can be aligned effectively (Own Source).

The structure to achieve this alignment may be found in the biosphere reserve model with its abovementioned ecological zonation and living landscape approach and the following two unique advantages offered by the MBR concept (Programme on Man and the Biosphere, 2005:8):

- Firstly, a biosphere reserve is based on an international definition of a specific area and protected by national law. As such, there is governance frameworks allowing for the implementation of the long-term processes needed to establish and maintain the resilience that leads to eventual sustainability.
- Secondly, it offers the opportunity to manage the ever-present dilemma of reconciling the conservation of biodiversity with its sustainable use through the development of regional specific answers to these opposing polarities. "UNESCO biosphere reserves are about solving intractable conflicts".

Governance relates to "the processes of interaction and decision-making among the actors involved in a collective problem that lead to the creation, reinforcement, or

reproduction of social norms and institutions" to address such a collective problem (Business dictionary, 2017).

The unification of sustainable agricultural practices with the biosphere reserve concept seems a natural choice as it provides the framework to integrate the ecological gains made on field and farm level in order to replicate it on landscape and biosphere level (Own Source).

As the area encompassing the proposed MBR is primarily owned by private landowners, the project sponsors (Marico River Conservation Association, in cooperation with the four major Agricultural Unions representing the land owners) have already established the not-for-profit Marico Biosphere Reserve Management Authority (NPC) to coordinate the management of the proposed MBR (MRCA, 2017:33).

The Board of the Marico Biosphere Reserve Management Authority (NPC), which consist of landowners in the biosphere reserve, may institute standing or ad hoc technical task teams from the relevant stakeholders to plan, organise, coordinate, implement and control specific projects within the MBR (MRCA, 2017:33).

To this effect, it is envisaged that subject experts from the Advisory Board will chair and/or guide such task teams as far as possible. Although not limited to, this Advisory Board will include scientists from the Management, Natural and Social Sciences. A MOU to this effect has been concluded with the North West University (MRCA, 2017:35).

This Management Authority will thus guide the processes of planning, organising, coordinating and control with regard to the implementation of sustainable agricultural practices within the biosphere reserve as such through a standing technical task team under the auspices of an expert as indicated in figure 4 (MRCA, 2017:33).

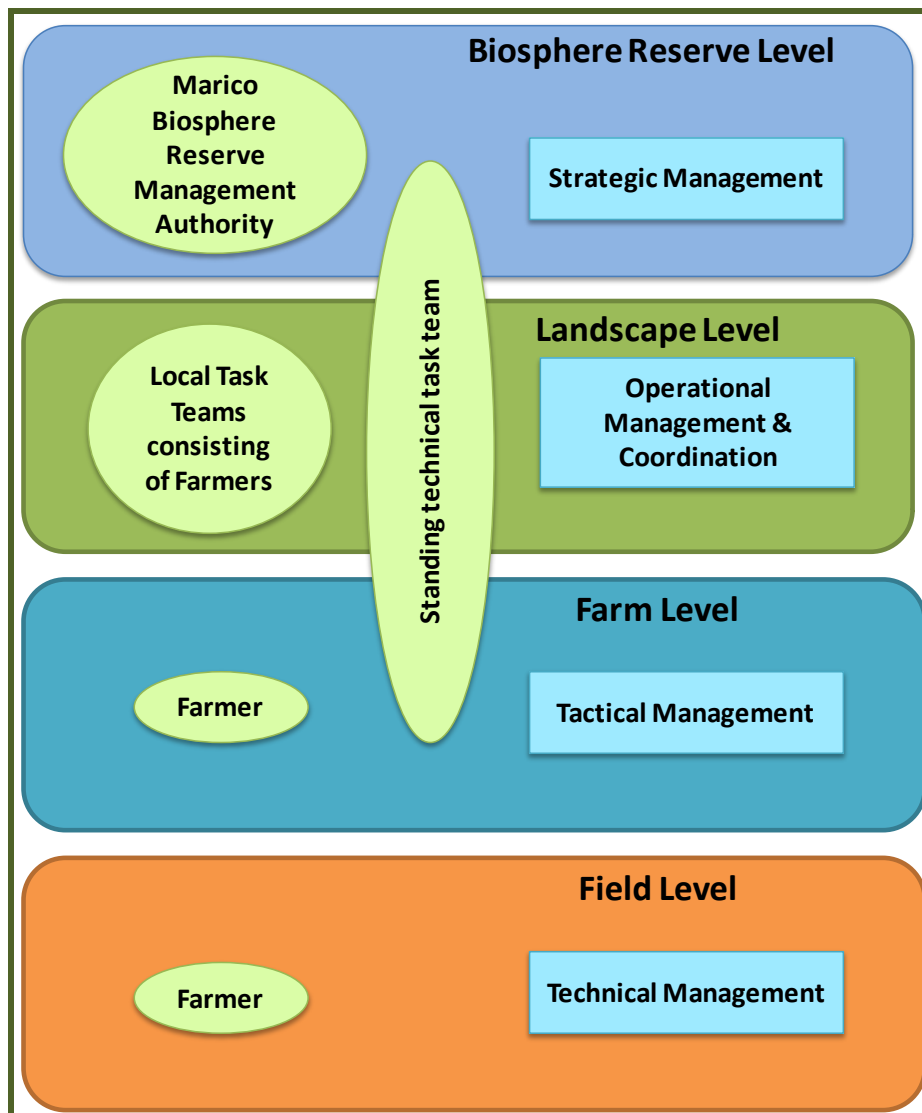


Figure 2.3: Governance framework of the MBR

To put the implementation of sustainable agricultural practices within the biosphere reserve into perspective, it must be seen as part of the latter’s business model as unpacked in figure 2.5 (MRCA, 2017:33).

3.2.2 MBR: The Business Model

Vision: “A Healthy Environment and Happy People”.

<p>Key Partners Who must we partner with?</p> <p>Interpret from number 1- 9.</p> <ol style="list-style-type: none"> The land owners of the MBR. Agri NW & TLUSA. Conservation Institutions & NGOs. Local businesses as well as the corporate society. READ. 8 NWPB. DEA (MAB & NRM). DWS. NWU. Marico Info Centre. Mmutlwa wa Noko. 	<p>Key Activities What Key Activities do we require?</p> <ol style="list-style-type: none"> Cultivating and protecting environmental, historical, intellectual, human and social capital. Improving the economic and processed capital of the region. Contributing to the Quality of Life and Community Wellbeing in the region. Research and Capacity building. 7 Stakeholder/customer education. 	<p>Value Proposition What value do we deliver to the Stakeholders and Customers?</p> <p>The MBR creates integrated value to form a sustainable base of regional assets which contribute to the Quality of Life and Community Wellbeing in the area through conservation of its natural resources.</p> <p>2 It also facilitates the applicable processes towards improved basic services, public goods and overall regional stability and sustainability.</p> <p>(<u>Integrated value</u>: Ecological, historical, intellectual, human, social, and economic capital).</p>	<p>Stakeholder Relationships What type of relationship does each of our Stakeholder Segments expect us to establish and maintain collaboratively?</p> <p>A long-term beneficial/customer/ sustainability orientated relationship that balances the needs of the environment with those of the people. 4</p>	<p>Stakeholder Segments For whom are we creating value?</p> <ol style="list-style-type: none"> The land owners of the MBR. Local communities and community organisations in the MBR. Local businesses as well as the corporate world. Conservation Institutions & NGOs. Society at large/customers of the MBR, its products & services. Local & district Municipalities. National & Provincial Departments. 1
<p>Cost Structure What are the most important costs inherent in our business model?</p> <ol style="list-style-type: none"> Branding, marketing & promotion of the MBR, its products & services. Improving the economic and processed capital of the region. Research, Capacity building and Stakeholder/customer education. HR, Operations, Logistics, Finances, Value Chain Management costs. 9 		<p>Revenue Streams For what value are our customers really willing to pay?</p> <ol style="list-style-type: none"> International eco-tourism route for the mobility impaired (MI). 5 Branding and marketing of local produce and services, including water. Dark Sky Park, slack packing protected tree routes and run of the mill eco-tourism. Sustainable Agricultural Products that lead to Carbon Credits. 		

Figure 2.4: Business Model of the MBR

3.2.3 The fundamental character of strategy

“Where does scientific knowledge come from? A good scientist pushes to the edge of knowledge and then reach beyond, forming a conjecture – a hypothesis- about how things work in that unknown territory...In the same way, a good business strategy deals with the edge between the known and the unknown. A good strategy is, in the end, a hypothesis about what will work. Not a wild theory, but an educated judgement.” (Rumelt, 2012:243)

“A good strategy has a fundamental structure that is logical and consists of three elements namely a diagnosis, a set of guiding principles or broad goals and a coherent action plan. The guiding principles or broad goals denote the methodology needed to tackle the challenge(s) identified during the diagnosis... Like a route marker, it indicates the course to be taken without specifying the details of the journey as the latter are contained in the coordinated policies, outcomes and resource commitments that constitute the coherent action plan designed to fulfil the guiding principles.” (Rumelt, 2012:7)

3.3 Results

3.3.1 Aim of the SAMF

The aim of the SAMF was established as follows:

“To create integrated value for the region, its people and society at large through the implementation and maintenance of integrated multi-dimensional sustainable agricultural systems”.

These integrated multi-dimensional sustainable agricultural systems must contribute towards the attainment of the following goals in order to reach the aforementioned aim:

- To accumulate ecological profit through protecting and improving the current ecological resilience and capital.
- To enhance the human, social and intellectual capital of the region so as to realise result driven ecological innovation.

- To counter the precedence of short term gain on the balance sheet over the less impressive longer-term human, social, intellectual, financial and ecological profit.
- To ensure a positive cash flow while consistently producing above averages returns.

3.3.2 The goals of the SAMF

In order to reach the aim of the SAMF the abovementioned goals need to be supported by the following sub goals: (Own Source)

	Goal	Sub-Goals
1.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	Ecological capital and long-term productivity are being improved through complementary, integrated and coordinated field, farm, landscape and biosphere reserve scale interventions that enhance the human, social, intellectual and financial capital as well. The current conventional agricultural systems must be transformed to sustainable agri-practices.
2.	To enhance the human, social and intellectual capital of the region so as to realise result driven ecological innovation.	The mind-set, knowledge, skills and self-reliance of the landowners are being optimised. The collective competence of the relevant landowners is aligned to address the challenge.
3.	To counter the precedence of short term gain on the balance sheet over the less impressive longer-term human, social, intellectual, financial and ecological profit.	The time it takes for the biological processes to renew the ecological capital and the time spent on learning new skills and technologies (Kesavan, 2008:41) is identified and appreciated by all associates. The long-term advantages of the abovementioned processes are made visible to all stakeholders.
4.	To ensure a positive cash flow while consistently producing above average returns.	Ground-breaking configurations of capital that will enable imaginative lateral and vertical partnerships to create multifunctional agricultural systems are devised and implemented. The principle of collaboration is operationalised through collective marketing and buying systems within the biosphere reserve.

Table 1.6: The guiding principles for the SAMF

3.3.3 The SAMF

In order to reduce the enormity of the endeavour into easily executable and controllable management goals, sub-goals, objectives and specific tasks that can be aligned to definite geographical areas, specific spheres of responsibility and the effective employment of resources, this framework consists of a strategic, an operational, a tactical and a technical level (Own Source).

For the purpose of this framework, the aforementioned levels are defined as follows: (Own Source)

- Strategic: All those collective objectives to be realised on the level of the MBR.
- Operational: The actions that must be taken on landscape level to optimise the positive impacts generated on the two lower levels.
- Tactical: Farm level activities applied by the different landowners to implement and maintain integrated multi-dimensional sustainable agricultural production systems (IMSAS).
- Technical: The actions taken by the landowners on field level to create and sustain the building blocks of the IMSAS.

The implementation and maintenance of these integrated multi-dimensional sustainable agricultural systems requires that the following sub-goals are reached on each of the abovementioned levels to attain the goals and thus the strategic aim of the framework: (Own Source)

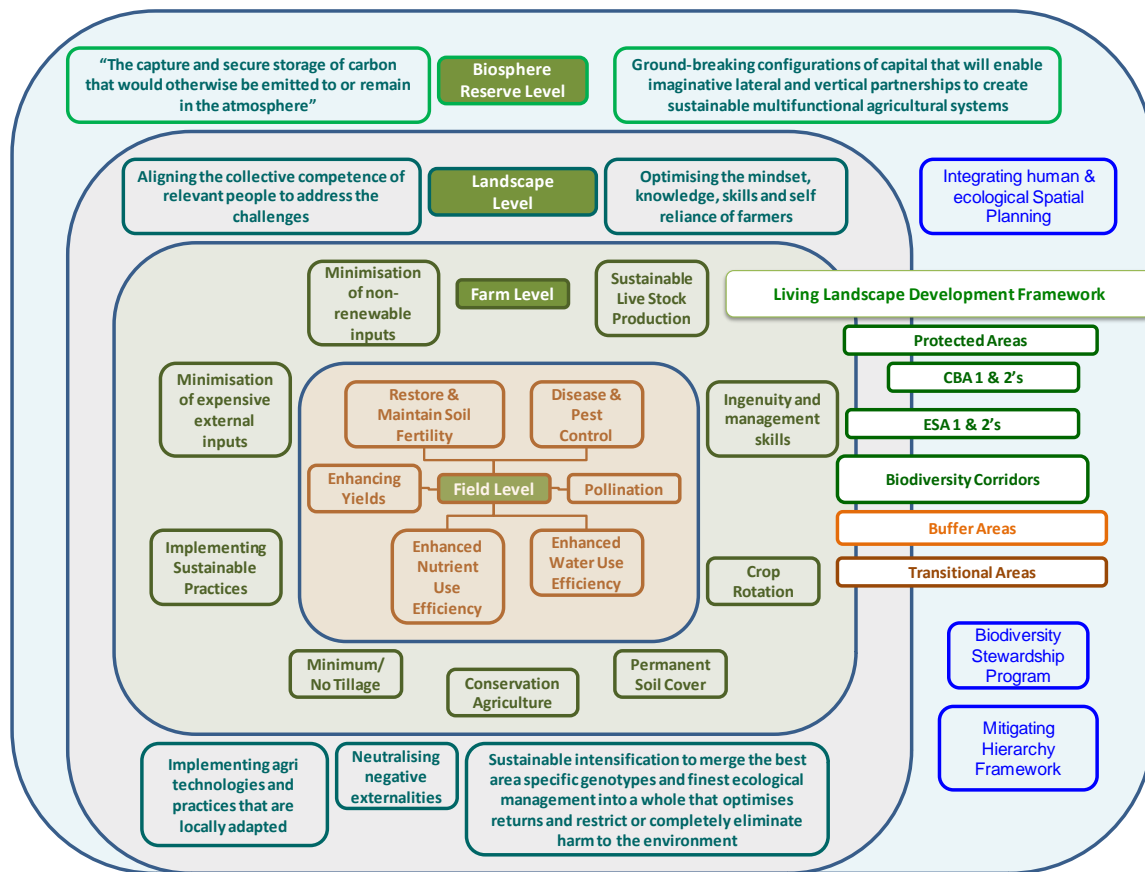


Figure 2.5: The coherent actions to be implemented (Source: Own).

To allow the Management Authority of the Biosphere Reserve, the local task teams and the individual farmers (as previously indicated) to bridge the space between the theory and the practical implementation of this integrated multi-dimensional sustainable agricultural framework, the identified goals and sub-goals as well as the objectives to be attained are linked to the specific tasks and possible constraints by means of an action plan which includes the following: (Own Source)

- The level on which the action(s) must be instituted and the responsible entity.
- The goals.
- The sub – goals.
- The objectives.
- The specific tasks.
- Possible constraints.
- The main source(s) from which the information was obtained.

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
1.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To integrate the human & ecological spatial planning.	<ul style="list-style-type: none"> a. To improve the overall resilience of the greater ecological systems. b. To improve the ecological sustainability and long-term productivity through the integrated, complementary and coordinated farm- and landscape-scale interventions. 	<ul style="list-style-type: none"> a. To implement the Living Landscape Development Framework. b. To expand and link the existing protected areas to include as many of the Critical Biodiversity Area 1 & 2s and biodiversity corridors as possible. c. To include the Ecological Support Area 1 & 2's in conservancies. d. To improve the representation within protected-area networks. e. To enhance the management and restoration of existing protected areas. f. To maximize resilience by designing new ecological areas and restoration sites. g. To protect, manage and restore movement corridors, stepping stones, and refugia as well as ecosystem functions. 	Stakeholder commitment.	Baudry et al (2000:122) and Hassan et al (2005:780)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
2.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To incorporate the Mitigating Hierarchy Framework into the biosphere management processes.	<p>a. To reduce the consequences of adverse ecological impacts to the minimum.</p> <p>b. To increase the overall resilience of the greater ecological systems.</p>	<p>To implement the following hierarchy of actions in order to deal with unavoidable ecological loss:</p> <ul style="list-style-type: none"> • <u>Avoid or Prevent</u>: Consider options to avoid or prevent significant adverse impacts, such as changing the location or scale of a project. • <u>Minimise</u>: Consider alternatives for minimising the extent and nature of adverse impacts, such as options in terms of site management, technologies and phasing. • <u>Rehabilitate</u>: Consider opportunities for onsite rehabilitation of ecological infrastructure and ecosystems damaged as a consequence of project development. • <u>Offset</u>: Counterbalance residual adverse ecological impacts with offsite investments in interventions that seek to provide a net ecological benefit. 	Arguably, some ecological impacts cannot be offset – for instance, the extinction of a species.	(Department of Environmental Affairs, 2015:7)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
3.	To ensure a positive cash flow while consistently producing above averages returns.	<ul style="list-style-type: none"> a. To enhance the overall resilience of the greater ecological systems. b. To pave the way paved for the sale of carbon credits over time. 	To plan, organise, implement, coordinate and control the incarceration and fixation of carbon on biosphere reserve level.	<ul style="list-style-type: none"> a. To implement the reforestation and rehabilitation of fragmented forests and degraded areas b. To introduce reduced tillage and direct seeding. c. To rehabilitate as many wetlands as possible. 	The management process is complex.	(German Commission for UNESCO, 2011:55)
4.	To ensure a positive cash flow while consistently producing above averages returns.	The dilemma of “cost for maintenance of ecological resilience must be paid upfront while the benefits mainly accrue to probably unknown people sometime in the future” is mitigated.	<ul style="list-style-type: none"> a. To devise ground-breaking configurations of capital in cooperation with the corporate world. b. To make this affordable capital available to the farmers in the Biosphere Reserve. 	<ul style="list-style-type: none"> a. To develop imaginative lateral and vertical partnerships between the corporate world and the farmers in the Biosphere Reserve. b. To create sustainable multifunctional agricultural systems through these partnerships. 	Subject of further study.	(Pretty, 2006:1115)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
5.	To ensure a positive cash flow while consistently producing above averages returns.	To operationalise the principle of cooperation through collective marketing and buying systems.	<ul style="list-style-type: none"> a. To reach economy of scale on financial level. b. To guarantee the delivery of volume c. To drive down costs. d. To earn market share. 	<ul style="list-style-type: none"> a. To implement a performance-based business model where the commercial buying and selling functions that can collectively be better executed on behalf of the farms and other businesses in the MBR, are done by the latter. b. To include at least the collective branding, marketing and promotion of the produce and services of the farms and other businesses in the MBR who prefer to be part of the brand. 	Results will be needed before the majority of the landowners will buy in.	(MRCA, 2017:18)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
6.	To counter the precedence of short term gain on the balance sheet over the less impressive longer-term human, social, intellectual, financial and ecological profit.	To make the advantages of the long-term processes needed to reach the aim visible to all stakeholders.	<ul style="list-style-type: none"> a. To build understanding for the time it takes for the biological processes to renew the ecological capital. b. To abridge the time spent on learning new skills and technologies. 	<ul style="list-style-type: none"> a. To optimise education, public awareness and involvement. b. To enhance the training of specialists and managers working in the biosphere reserve. c. To promote sustainable development through education and capacity building. d. To implement conservation and sustainable agricultural workshops for the land owners. 	Funding.	(MRCA, 2017:23)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority

	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
7.	To enhance the human, social and intellectual capital of the region so as to realise result driven ecological innovation.	To optimise the mind-set, knowledge, skills and self-reliance of the landowners.	<ul style="list-style-type: none"> a. To optimise the human, social and intellectual capital of the region in order to realise result driven ecological innovation. b. To enhance the overall resilience of the greater ecological systems due to a changed collective mindset. 	<ul style="list-style-type: none"> a. To provide support for research, monitoring and information exchange. b. To optimise education, public awareness and involvement. c. To promote sustainable development through education and capacity building. d. To implement conservation and sustainable agricultural workshops for the land owners. 	Funding.	(MRCA, 2017:23)
8.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To implement Agri-technologies and practices that is locally adapted.	<ul style="list-style-type: none"> a. To align the collective competence of the region’s people towards mission accomplishment. b. To enhance the overall resilience of the greater ecological systems. 	<ul style="list-style-type: none"> a. To conduct research on the pathways for adapting agri-technologies and practices that will ensure that the optimum local performance is attained. b. To plan, organise, coordinate and control the employment of these constructive drivers on landscape level. 	Funding.	(Pretty, 2008:451)

Strategic Actions: Biosphere Reserve Level – Responsibility of the Management Authority						
	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
9.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To optimise the mind-set, knowledge, skills and self-reliance of the landowners.	To neutralise negative externalities associated with conventional agri-practices.	To address the challenges of negative externalities through education, public awareness and involvement of community organisations.	Funding.	(MRCA, 2017:23)

Table 1.7: The action plan to be implemented on biosphere reserve level

Operational Actions: Landscape Level - Responsibility of the Local Task Teams						
	Goal	Sub-Goal(s)	Objective(s)	Specific tasks	Possible constraints	Reference
1.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To implement sustainable intensification effectively.	To create complete agri-systems that optimises returns and restricts or completely eliminates harm to the environment.	To merge the top locally adapted genotypes and finest ecological management.	Locally adapted genotypes may be in short supply.	(Pretty, 2008:451)
2.		To manage the landscape elements.	<ul style="list-style-type: none"> a. To achieve integrated pest management with less herbicide use through habitat creation for control species. b. To improve biodiversity and pollination. c. To protect against surface water contamination. d. To prevent wind and soil erosion. 	To establish, manage and maintain vegetation strips, hedges and other landscape elements on farm level scale.	Management of landscape must be done, requires all stakeholders to be committed	(Gardiner, et al., 2009:159)

Table 1.8: The coherent action plan to be implemented on landscape level

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers

	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
1.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To institute sustainable live stock production.	<ul style="list-style-type: none"> a. To enhance soil composition, animal welfare, feed conversion and biodiversity b. To increase the retention of calcium and phosphorus in the ecological systems. c. To improve the connectivity between habitat pockets. d. To lower temperatures at pasture level and produce less greenhouse gasses. e. To increase the carrying capacity and the annual meat production (live weight). 	<ul style="list-style-type: none"> a. To combine the concept of agroforestry where trees, shrubs and herbage are combined with livestock. b. To actively manage and integrate specific ecological resources and/or processes. c. To enhance the overall productivity of the area through introducing and establishing of the biophysical interactions between component species. 	Financial return may be between 3 -6 years.	(Broom, et al., 2013:6)
2.		To utilise the best cultivars for the specific area.	<ul style="list-style-type: none"> a. To enhance and/or stabilise yields. b. To improve the resistance to water stress and the control of pests. c. To decrease the utilisation of fertiliser and herbicides. 	<ul style="list-style-type: none"> a. To utilise crops that are unaffected by both biotic and abiotic pressures. b. To use crops with the characteristics that promotes rhizosphere actions. 	Costs/ accessibility of new and adapted cultivars.	(Tilman, et al., 2002:674)

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers

	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
3.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To utilise the advantages of split fertilisation.	<ul style="list-style-type: none"> a. To decrease the danger of contaminating surface and/or ground water b. To decrease the utilisation of chemical fertiliser. c. To enhances the crops' capability to absorb nutrients. 	To apply chemical <i>and</i> organic fertiliser.	Given the increase in the number of fertiliser applications needed labour and energy needs will increase.	(Zebarth, et al., 2009:117)
4.		To optimise yields through the use of Bio-fertiliser.	<ul style="list-style-type: none"> a. To improve nutrient availability. b. To drastically reduce the use of chemical fertiliser. 	To apply living micro-organisms to the soil, seed and/or plant surfaces.	Commercialisation rate of Bio-fertiliser is still insufficient.	(Malusá, et al., 2012:241)
5.		To reap the benefits of using only organic fertilisation.	<ul style="list-style-type: none"> a. To decrease the danger of contaminating surface and/or ground water. b. To optimise the organic activity in the soil. c. To lessen the utilisation of chemical fertiliser. d. To decrease transport distance through the use of fossil fuel. 	To apply organic fertiliser only.	The optimisation of nitrogen in the soil is more complex.	(Birkhofer, et al., 2008:2301)

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers						
	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
6.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To optimise the utilisation of water.	<ul style="list-style-type: none"> a. To decrease water use by enhanced water use efficiency. b. To lessen the salinisation of soil. c. To reduce evaporation through utilising cover - crops or mulch. 	<ul style="list-style-type: none"> a. To optimise the use of drip irrigation. b. To vigorously apply cover crops and mulch. 	Equipment, installation and management costs may be high.	(Lopes, et al., 2011:608)
7.		To optimise the utilisation of ecological pesticides.	<ul style="list-style-type: none"> a. To reduce the contamination of water/soil from chemical pesticides. b. To negate the risk to human health. 	Insect repellents obtained from plants or plant extracts are utilised.	<ul style="list-style-type: none"> a. Relatively scarcity of these pesticides b. Scientific knowledge still being explored. 	(Regnault-Roger & Philogène, 2008:44)
8.		To increase the use of biological pest control	To diminish the risks to human health, soil and water contamination.	To control weeds, pests, and diseases through the introduction of ecological enemies and pheromones into the area.	Cost, management and knowledge intensive.	(Altieri & Nicholls, 2004:32)

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers

	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
9.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To strengthen the individual agri-systems through the judicious combination of different crops within a crop rotations system.	<ul style="list-style-type: none"> a. To enhance biodiversity. b. To reduce pest and weed infestations as well as the use of herbicides. c. To increase biological soil activity d. To inhibit the use of fertiliser. e. To reduce leaching and erosion through the use of cover crops. 	<ul style="list-style-type: none"> a. To integrate dissimilar crops in rotations with cover crops. b. To utilise leguminous crops as part of the mix to increase the nitrogen contents of the soil. 	More labour intensive than mono-cropping.	(Scholberg, et al., 2010:27)
10.		To harvest the benefits of intercropping.	<ul style="list-style-type: none"> a. To decrease pest and disease impact. b. To enhance land productivity and nitrogen content of soils. c. To improve soil fertility and structure. d. To reduce input costs. 	<ul style="list-style-type: none"> a. To produce more than one type of crop simultaneously on a specific field. b. To utilise legumes as part of the mix to increase the nitrogen contents of the soil. 	The complexity of management system is amplified and special equipment is needed for harvesting. Labour may increase.	(Malézieux, et al., 2009:44)

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers						
	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
11.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To implement agroforestry by utilising fruit, nut and/or timber trees.	<ul style="list-style-type: none"> a. To enhance land productivity, diversity of production and biodiversity. b. To produce material for mulch. c. To diminish soil erosion as well as nutrient leaching. d. To protect crops from severe wind and solar rays. 	Intercropping between crops and woody plants is done and trees are planted in pastures.	Increase in labour needed.	(Rigueiro-Rodríguez, et al., 2009:34)
12.		To optimise the utilisation of Allelopathic plants	To mitigate the pressure from soil borne pests, diseases and weeds without it being necessary to utilise herbicides.	To include Allelopathic plants in crop rotation as either inter- or cover crops as part of a trap/push/pull strategy.	Control of Allelopathic plants is management intensive and more research is needed.	(Ratnadass, et al., 2012:284)

Tactical and Technical Actions: Farm and Field Level - Responsibility of the Individual Farmers						
	Goal	Sub-Goals	Objectives	Specific tasks	Possible constraints	Reference
13.	To accumulate ecological profit through protecting and improving the current ecological resilience and capital.	To reap the benefits of direct seeding into living cover crops or mulch.	<ul style="list-style-type: none"> a. To reduce energy needed for seedbed preparation, herbicide utilisation and weed growth. b. To decrease wind and water erosion as well as soil compaction. c. To increase soil organic matter and the activity of in soil biota. d. To enhance carbon sequestration. 	To plant directly in the cover of the foregoing crop or crop remains as part of a no tillage regime.	Management complicated, risky if sufficient knowledge not available.	(Soane, et al., 2012:69)
14.		To optimise the advantages of reduced tillage.	<ul style="list-style-type: none"> a. To decrease wind and water erosion as well as soil compaction. b. To increase soil organic matter and the activity of in soil biota. c. To enhance carbon sequestration. 	To prevent soil inversion although ripping may take place.	Weed control is difficult.	(Soane, et al., 2012:71)

Table 1.9: The coherent action plan to be implemented on farm and field level

3.4 Conclusion and recommendations

According to Rumelt (2012:243) “a good strategy is, in the end, a hypothesis about what will work. Not a wild theory, but an educated judgement”. Measured against this, the implementation of the proposed sustainable agricultural framework is achievable by the MBR management authority and will support the existing ecological resources, processes and ecosystem services in the biosphere reserve through result driven ecological agricultural innovation.

As the implementation of the proposed sustainable agricultural framework needs to be done by humans, there are however three caveats that must be included with the abovementioned conclusion. Although there is broad consensus between academics, organised agricultural, farmers and even agri-businesses like SENWES and NWK that the time for migration to sustainable agricultural practices is *now*, human nature’s first question is inevitably “what’s in it for me” or “what will it cost?”

Secondly, human nature must first unlearn the thought patterns of decades before it can really internalise new thought patterns. Thirdly, uncertainty is often thought of as carrying unacceptable risks – the markets need certainty.

Based on these three core truths it is recommended that further research must be done to seek answers to the following questions:

- How does the financial feasibility of sustainable agricultural practices compare with that of conventional agricultural systems?
- What impact will the implementation of these sustainable agricultural practices have on the value of agricultural land in the area?
- What barriers to implementation of these sustainable agricultural practices do the landowners foresee?
- According to the landowners, what can be done to ease the process of migration to sustainable agricultural practices?

To further test the overall viability of the proposed sustainable agricultural framework for the biosphere, possible answers to some of these questions will be searched for in the following part of this study.

CHAPTER 4: IMPLEMENTATION OF THE SAMF: ARTICLE 2.

4.1 Introduction

According to Rumelt (2012:243) “a good strategy is, in the end, a hypothesis about what will work. Not a wild theory, but an educated judgement”. Measured against this, the implementation of the proposed sustainable agricultural framework is achievable and will support the existing ecological resources, processes and ecosystem services in the biosphere reserve through result driven ecological innovation.

As the implementation of the proposed sustainable agricultural framework needs to be done by humans, there are however three caveats that must be included with the abovementioned conclusion.

Although there is broad consensus between academics, organised agricultural, farmers and even agri businesses like SENWES and NWK that the time for migration to sustainable agricultural practices is *now*, human nature’s first question is inevitably “what’s in it for me” or “what will it cost?”

Secondly, human nature must first unlearn the thought patterns of decades before it can really internalise new thought patterns.

Thirdly, uncertainty is often thought of as carrying unacceptable risks – the markets need certainty.

4.1.1 Problem statement

Given the abovementioned abridgment, the problem statement for this study has been formulated as follows:

“What barriers and keystones will influence the implementation of the proposed sustainable agricultural framework?”

4.1.2 Research objectives

Based on the abovementioned core truths and problem statement the research objectives were formulated as follows:

4.1.2.1 Main objective

To assess the feasibility of the SAMF.

4.1.2.2 Secondary objectives

- To compare the financial feasibility of sustainable agricultural practices with that of conventional agricultural systems.
- To resolve what barriers the landowners identified to implementing these sustainable agricultural practices.
- To establish what can be done to ease the process of migration to sustainable agricultural practices.

4.1.3 Research methodology.

The literature study firstly led to different methods for comparing the financial feasibility of sustainable agricultural practices with that of conventional agricultural systems. These different quantitative methods were utilised to determine the financial feasibility of the separate sustainable agricultural practices within this agricultural management framework when compared to the conventional agri-systems.

Secondly previous studies provided some insights into the possible barriers to the greater uptake of sustainable agricultural practices. These studies also highlighted the potential keystones of sustainable agricultural practices and assisted in the compilation and interpretation of the quantitative survey that was utilised to determine the mind-set of the target group with regard to the SAMF.

The study population consisted of the 186 landowners in the different buffer zones of the Marico Biosphere Reserve. The survey was first tested with a small sample of the target group.

It was then revised and sent to the study population via SurveyMonkey.com. After the analysis of the responses and the interpretation thereof, interviews were done with 6 persons from the target group to deliberate on the results obtained.

4.2 The financial feasibility of sustainable agricultural practices.

4.2.1 Literature Review.

“The Social Responsibility of Business is to Increase its Profits” (Friedman, 1970:5). Although the current social responsibility of businesses is much more comprehensive and therefor also much more complex, any firm still needs to expand its shareholders’ value. The foremost method of attaining this objective is reinvesting capital in ventures with a higher return than the cost of capital for the business (Brigham & Houston, 2009:307).

To determine the feasibility of these ventures, the prospective cash flows thereof can be forecasted and discounted to its net present value (NPV). Accepting the venture when the NPV of the prospective cash flows beats the costs will increase the shareholders’ value. To determine the NPV, a discount rate, which equals the venture’s cost of capital, is needed (Brigham & Houston, 2009:307).

To prevent using too much of its future borrowing capacity and to keep the debt ratio from becoming too high, most firms also utilise preferred stock or equity to finance these ventures (Brigham & Houston, 2009:308).

As very few of the farmers in the study area deals with preferred stock or the issuance of new shares, these two subjects do not form part of the current deliberations. For the purposes of these calculations, capital will be considered to be made available either through debt or in the form of retained earnings.

4.2.1.1 Weighted Average Cost of Capital (WACC)

During the capital budgeting process for this study, the following formulas will be used to determine the Weighted Average Cost of Capital (WACC) which is defined

for this study as “a weighted average of the component costs of debt and common equity” (Brigham & Houston, 2009:311):

$$\begin{aligned} \text{WACC} &= (\% \text{ of debt}) * (\text{after-tax cost of debt}) + (\% \text{ of common equity}) * (\text{Cost of} \\ &\quad \text{common equity}) \\ &= w_d r_d (1-T) + w_c r_s \end{aligned}$$

Equation 1: WACC

where

- w_d = target weight of debt;
- r_d = interest rate on the firm's debt (before-tax component cost of debt).
- w_c = target weight of retained earnings;
- r_s = component cost of common equity raised by retained earnings, or internal equity (rate of return that investors require on the firm's common stock).

and

the after-tax cost of debts is calculated as follow to incorporate the savings that accrue from the tax deductibility of interest when using debt:

$$\begin{aligned} \text{After-tax cost of debt} &= \text{Interest rate on new debt} - \text{Tax savings which equals} \\ &= r_d - r_d T \\ &= r_d (1-T) \end{aligned}$$

Equation 2: After-tax cost of debt

Although there are no direct costs related to retained earnings, the latter are not for free as it carries a definite opportunity cost. This is incurred due to the fact that the net earnings remaining after tax belong to the common stockholders or owners of the firm in the case of a private company (Brigham & Houston, 2009:313).

They are compensated for their input through receiving dividends from the net earnings after tax which they can invest as they please. If these funds are reinvested in the business and not paid to the stockholders as dividends, the latter require at least as much return on these funds as they have could gain on alternative investments with similar risk (Brigham & Houston, 2009:313).

Although the abovementioned required rate of return can be determined by using either the Capital Asset Pricing Model or the discounted dividend model, (Brigham & Houston, 2009:315) neither of these are very accurate due to a lack of reliable inputs as this study focuses primarily on private companies and other smaller legal entities for which beta and share prices are not readily available.

According to numerous empirical studies the average risk percentage on a company's stock over its own bonds varies between 3% and 5%. Given this substantiation, the firm's own long-term debt may be utilised to estimate its cost of equity by adding a judgmental risk premium of between 3% and 5% to the interest rate payable on long-term loans (Brigham & Houston, 2009:315).

If the applicable bond yield is 10% and the average risk premium is taken as 4% (3+5/2) the Bond-Yield-plus-Risk-Premium Approach will provide the following required rate of return:

$$\begin{aligned} r_s &= \text{Bond yield} + \text{Risk premium} \\ &= 10\% + 4\% \\ &= 14\% \end{aligned}$$

Equation 3: Bond-Yield-plus-Risk-Premium

As the aim of the study is to merely compare the financial feasibility of the conventional farming practices with that of the sustainable agricultural systems, the determining of the best possible capital structure, depreciation-generated funds as well as the costs of capital for projects of differing risk fall outside the scope of the research and will thus not be dealt with in this article.

4.2.1.2 Capital Budgeting and Net Present Value (NPV)

Capital Budgeting may be defined as “the process of planning expenditures on assets with cash flows that are expected to extend beyond one year” (Brigham & Houston, 2009:336) while Net Present Value (NPV) can be described “as a method of grading investment proposals using the NPV, which equals the present value of future net cash flows, discounted at the cost of capital”.

The NPV is ideal to compare the financial feasibility of the conventional farming practices with that of the sustainable agricultural systems as it indicates how much a project contributes to shareholder wealth—the larger the NPV, the more value the project adds to the business (Brigham & Houston, 2009:338).

NPV is calculated according to this formula:

$$NPV = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_N}{(1+r)^N}$$
$$= \sum_{t=0}^N \frac{CF_t}{(1+r)^t}$$

Equation 4: NPV

(Brigham & Houston, 2009:339)

The different symbols denote the following:

- CF₀ = the initial outflow of cash and is negative. On large projects, there may be more than one cash outflow over time;
- CF_t = the expected net cash flow at Time t;
- r = the project’s risk-adjusted cost of capital (WACC) and
- N = the life cycle of the project.

The NPV decision rules may be summarised as follows (Brigham & Houston, 2009, p. 340):

- Independent projects: If NPV exceeds zero, accept the project.

- Mutually exclusive projects: Accept the project with the highest positive NPV. If no project has a positive NPV, reject them all.

4.2.1.3 Capital Budgeting and the Internal Rate of Return/Modified Internal Rate of Return

The Internal Rate of Return (IRR) is defined as “the discount rate that forces a project’s NPV to equal zero”. (Brigham & Houston, 2009:341) and it is calculated as follows:

$$NPV = CF_0 + \frac{CF_1}{(1 + IRR)^1} + \frac{CF_2}{(1 + IRR)^2} + \dots + \frac{CF_N}{(1 + IRR)^N} = 0$$

$$0 = \sum_{t=0}^N \frac{CF_t}{(1 + IRR)^t}$$

Equation 5: IRR

The value of the firm increases if the project’s IRR exceeds the cost utilised to fund the project therefor the following decision rules apply: (Brigham & Houston, 2009:342)

- Independent projects: If IRR exceeds the project’s WACC, accept the project. If IRR is less than WACC, reject it.
- Mutually exclusive projects. Accept the project with the highest IRR, provided that IRR is greater than WACC. Reject all projects if the best IRR does not exceed WACC.

As the assumption that the project’s cash flow can be reinvested at the IRR is generally incorrect and leads to the IRR overplaying the real returns of the project, the modified internal rate of return will rather be used to compare the financial feasibility of sustainable agricultural practices with that of conventional agricultural

systems as it provides a better measure of profitability (Brigham & Houston, 2009:344).

The abovementioned Modified IRR (MIRR) may be defined as “the discount rate at which the present value of a project’s cost is equal to the present value of its terminal value, where the terminal value is found as the sum of the future values of the cash inflows, compounded at the firm’s cost of capital” (Brigham & Houston, 2009:345).

MIRR may be determined utilising the following equation:

$$\sum_{t=0}^N \frac{COF_t}{(1+r)^t} = \frac{\sum_{t=0}^N CIF_t (1+r)^{N-t}}{(1+MIRR)^N}$$

$$PV\ Costs = \frac{TV}{(1+MIRR)^N}$$

Equation 6: MIRR

Where

“COF_t is the cash outflow at time t, and CIF_t is the cash inflow at time t. The left term is the PV of the investment outlays when discounted at the cost of capital; the numerator of the second term is the compounded value of the inflows, assuming the inflows are reinvested at the cost of capital.

According to Brigham & Houston (2009:348) “the MIRR is the discount rate that forces the PV of the Terminal Value (TV) to equal the PV of the costs”.

4.2.1.4 Capital Budgeting and the Profitability Index

PI is expressed mathematically as the present value of the project’s cash inflows divided by the initial cash outflow (Meggison, et al., 2010, p. 257):

$$PI = \frac{\frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_N}{(1+r)^N}}{CF_0}$$

Equation 7: Profitability Index

The decision rule for PI: Invest if the project's PI is greater than 1.0 as this indicates that the PV of the cash inflows exceeds the initial cash outflow and desist investment if the PI is smaller than 1.0. (Meggison, et al., 2010:257). As the sustainable agricultural practices and conventional agricultural projects to be compared are of the same scale, it will not be necessary to address the inherent scale problem of the PI technique in this study.

4.2.1.5 Capital Budgeting and Estimating cash flows

In order to utilise the optimal cash flows for the calculations in this study, the enterprise budgets for the different conventional agricultural practices have been obtained from the provincial department of Agriculture (READ) and NWK as well.

4.2.1.6 Capital Budgeting and Unequal Project Lives

Given the fact that the financial feasibility of sustainable agricultural practices is compared with the same produce of conventional agricultural systems, the comparable projects will have equal project lives thereby negating the need to consider the adaptations needed for projects with unequal lives.

Where the NPV, MIRR and PI of the sustainable agricultural practices are compared with each other, the common life approach was followed (Brigham & Houston, 2009:383)

4.2.1.7 Risk Analysis in Capital Budgeting

Normally stand-alone risk, corporate or within-firm risk as well as market risk is considered during capital budgeting (Brigham & Houston, 2009:375). For this study, the latter two types of risk will not be dealt with as within-firm as well as

market risk are the same for sustainable agricultural practices and conventional agricultural systems in this context (Brigham & Houston, 2009:376).

In order to determine the stand-alone risk for sustainable agricultural practices a Sensitivity Analysis will be done to determine the percentage change in NPV that will result from a given variation in any of the input variables if all other things are held constant (Brigham & Houston, 2009:376).

This will provide a snapshot of the variability of the assets expected returns (Brigham & Houston, 2009:376).

4.2.1.8 Conclusions on Capital Budgeting Methods

Because NPV presents an absolute measure of the value that a project will contribute to shareholder wealth it is the most utilised method of capital budgeting. The Modified IRR includes a superior supposition in terms of reinvestment rates and avoids the problem of the multiple rates of return, therefor it is rather utilised than IRR (Brigham & Houston, 2009:355).

Due to limited capital and restricted land PI as capital budgeting tool is included as it provides for effective decision making when an agricultural venture needs to rank projects consisting of different crops (Meggison, et al., 2010:259).

4.2.1.9 Impact of sustainable agricultural practices: Variables

In his 2007 research that was done close to the southern part of the proposed Marico Biosphere Reserve area “Promoting conservation agriculture in South Africa: A case study among commercial grain producers in the North West Province” Du Toit (2007:18) reported an overall reduction of 12% in the production costs and an increase of respectively 34.21% and 35.68% in yield and net farm income over the first five years after migration from conventional to sustainable agricultural practices.

In terms of livestock production, Broom et al. (2013:6) reported increases in carrying capacity of six-fold per ha and an annual increase in live weight meat

production of 12 times (kg/ha/annum) where silvopastoral production systems were introduced in Colombia.

In 1995 Altieri and Rosset already reported a net increase of between 10% and 20% in the yields of orchards in California where agro-ecological practices were implemented to lessen the use of pesticides and to increase soil fertility, water retention and enhance the micro-climate in these orchards (Altieri & Rosset, 1996:178).

The “tree hog”, a water and thus an electricity saving device as well, developed in South Africa recently bring about a 62 % saving in water and pumping costs in orchards where it has been deployed (Botha, 2017:36)

The type of agricultural practices utilised for the comparison of the financial feasibility of sustainable agricultural practices with that of conventional practices were obtained from the Agri-Northwest Master Agricultural Plan as the most suitable for the area of the MBR (READ, 2012:68).

Local Municipalities	Citrus	Pomegranate	Olives	Pecan nuts	Vegetables	Maize	Sunflower	Sorghum	Livestock	Sheep	Beef
Ramotshere Moila	X	X	X	X	X	X	X	X	X	X	X
Ditso-botla	X		X	X	X	X	X	X	X	X	X
Mahikeng	X		X		X	X	X	X	X	X	X
Kgetleng-rivier	X		X	X	X	X	X	X	X	X	X

Table 1.10: Most suitable agricultural practices for the area of the MBR

From the preceding synopsis the following variables were selected to compare the financial feasibility of sustainable agricultural practices and the conventional agricultural systems:

	Agricultural Practice	Variable	Difference from Conventional Practices		Range according to literature in %		Type of Intervention	Parameters for study	Remarks
					From	To			
1	Annual Crops	Production Cost		↓	1.00	12.00	Conservation Agriculture	According to Range	Research was done in BR area
		Yield	↑		14.00	34.21			
2	Livestock	Live weight meat production	↑		1.00	1116.74	Silvopastoral	1.00 to 236.42	See note 1 & 2
3	Orchards	Yield	↑		10.00	20.00	Agro-ecological	According to Range	See note 3
		Production Cost		↓	1.00	10.09	Technology		

Table 1.11: Variables - financial feasibility of sustainable agricultural practices

Note 1:

Increase in live weight meat production in kg/ha/annum:					
	from	67.5	to	821.3	
			Increase in %	=	1116.74

Table 1.12: Increase in live weight – meat production

Note 2:

Adjustment of Agro-ecology range for local Circumstances			
Annual precipitation in Colombia in mm			866
Annual precipitation in BR area in mm			<u>550</u>
Difference in %			0.365
Adjusted increase in live weight meat production in kg/ha/annum in BR area			
Colombia increase	1116.74	minus	difference in rainfall
		Increase in Marico BR area	709.25
Divided by	3	to compensate for input costs	236.42

Table 1.13: Adjustment of Agro-ecology range for local Circumstances

Note 3:

Savings in water & electricity costs in orchards (ZAR)			
Water costs/annum/ha			1642.00
Electricity costs/annum/ha			<u>443.13</u>
Average combined W & E cost/ha/annum			2085.13
Saving of 62%			1292.78
Total production cost per ha			12 812.96
Minus saving on Water & Electricity/ha			11 520.18
Total saving in production cost/ha			10.09%

Table 1.14: Savings in water & electricity costs in orchards (ZAR)

4.2.2 Results: The financial feasibility of sustainable agricultural practices

Changeable Values:		Formula Results							
Assumptions:									
% of Debt:	0.65	r_d :	0.12						
		Tax:	0.30						
		(1 - T)	0.70						
% of Retained Earnings	0.35	Bond yield	0.11						
		RP	0.035						
r_e	0.145								
➡	WACC	=	0.1054						
	& The Re-Finance Rate	=	0.1054						
Under these conditions, every new Rand of capital raised will consist of 65.00 cents of debt with an after-tax cost of 8.40% and 35.00 cents of common equity (retained earnings) with an opportunity cost of 14.50%. The average cost of each whole Rand, or the WACC will be 10.54%									
Agricultural Practice	Variable	Difference from Conventional Practices		Range according to literature in %		Type of Intervention	Parameters for Study in %		Changeable Values
				From	To		From	To	%
1	Annual Crops	Production Cost	↓	1.00	12.00	Conservation Agriculture	1.00	12.00	12
		Yield	↑	14.00	34.21		14.00	34.21	24.1
2	Livestock	Live weight meat production	↑	1.00	1116.74	Sivopastoral ¹	1.00	236.42	235
3	Orchards	Yield	↑	10.00	20.00	Agro-ecological Technology	1.00	20.00	15
		Production Cost	↓	1.00	10.09		1.00	10.09	10.09
1 As these techniques take between 3 to 6 years to maturity, year 5 has been chosen as the first year of full production under the new system									

Table 1.15: Changeable Values

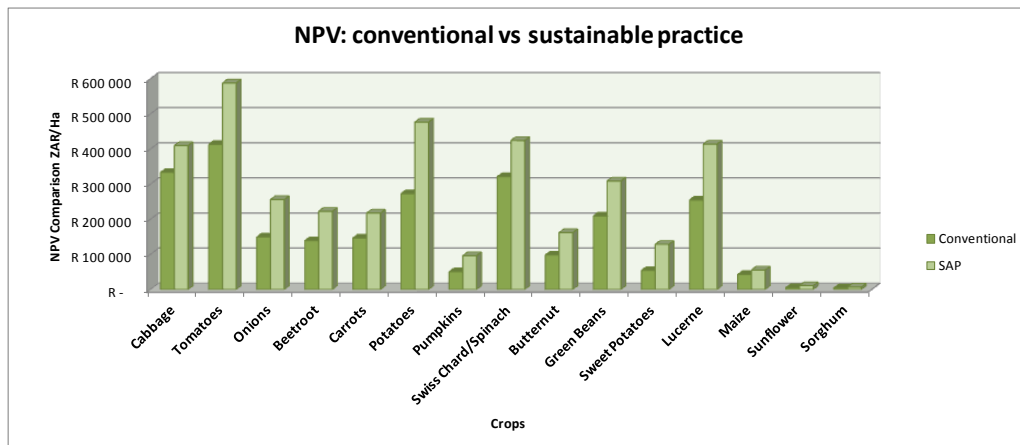


Figure 2.6: NPV: conventional vs. sustainable practice

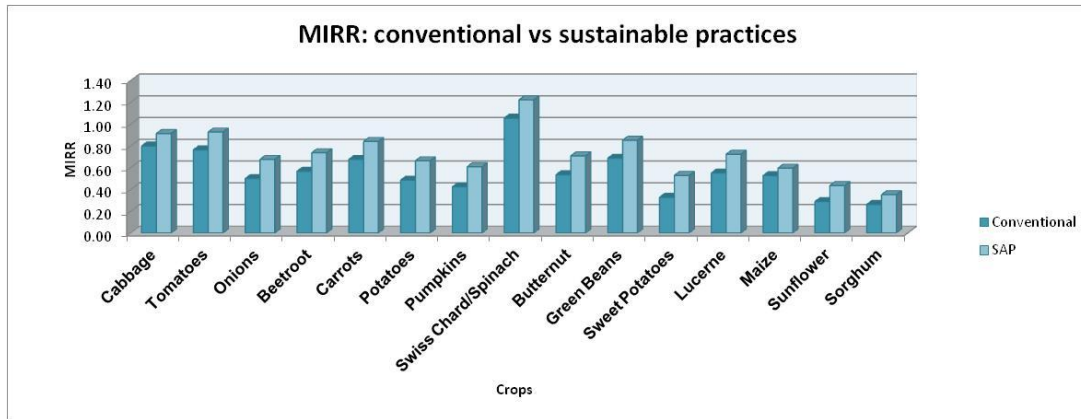


Figure 2.7: MIRR: conventional vs sustainable practices

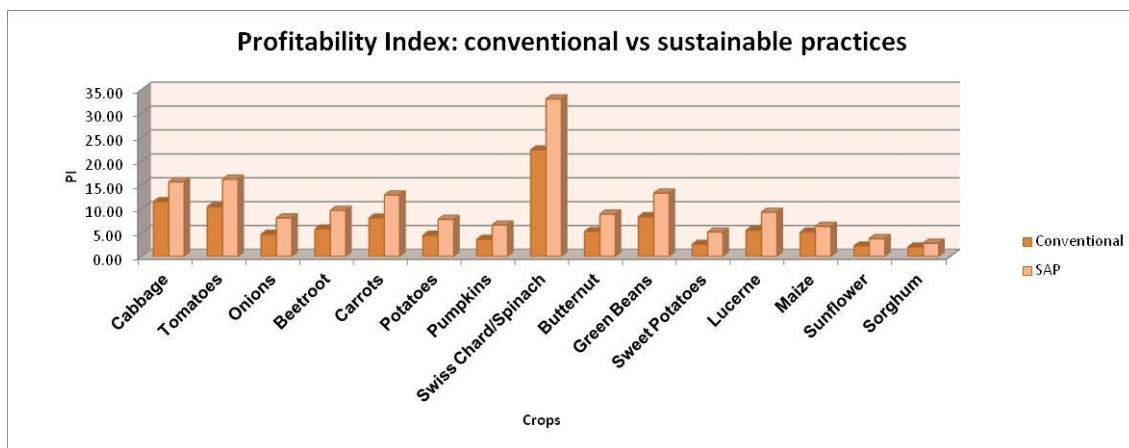


Figure 2.8: Profitability Index: conventional vs sustainable practices

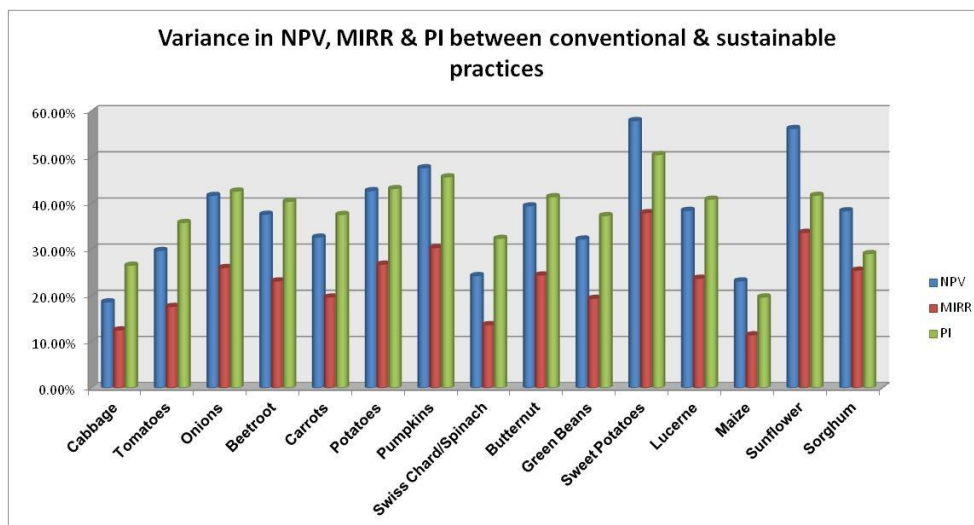


Figure 2.9: Variance in NPV, MIRR & PI: conventional & sustainable practices

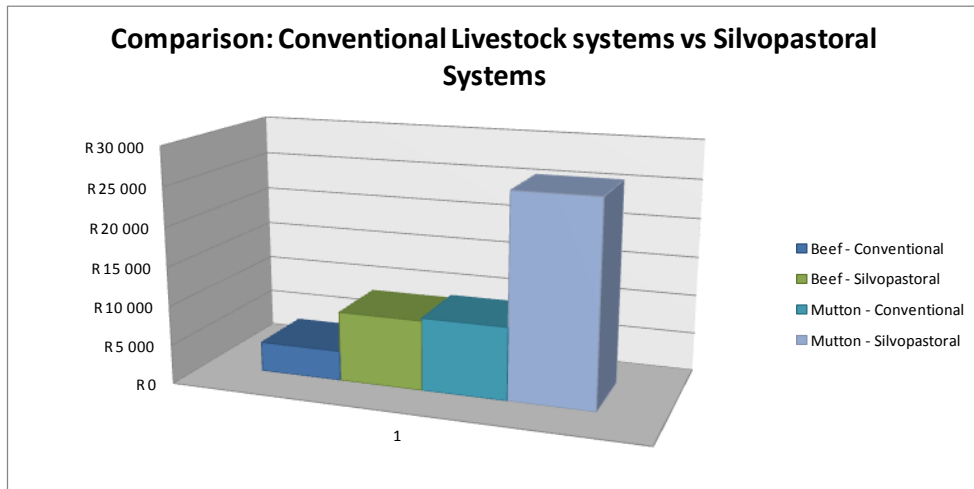


Figure 2.10: Comparison: Conventional Livestock vs Silvopastoral Systems

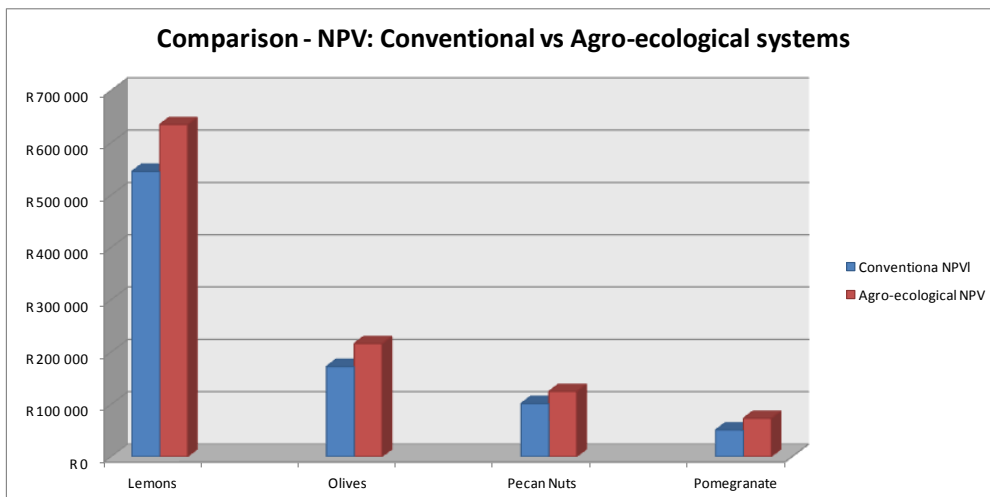


Figure 2.11: Comparison - NPV: Conventional vs Agro-ecological systems

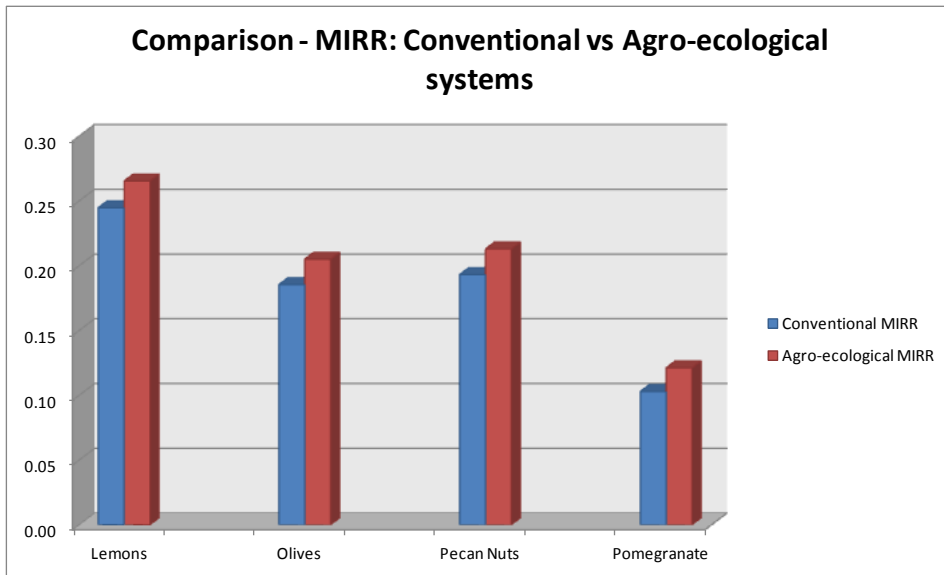


Figure 2.12: Comparison - MIRR: Conventional vs Agro-ecological systems

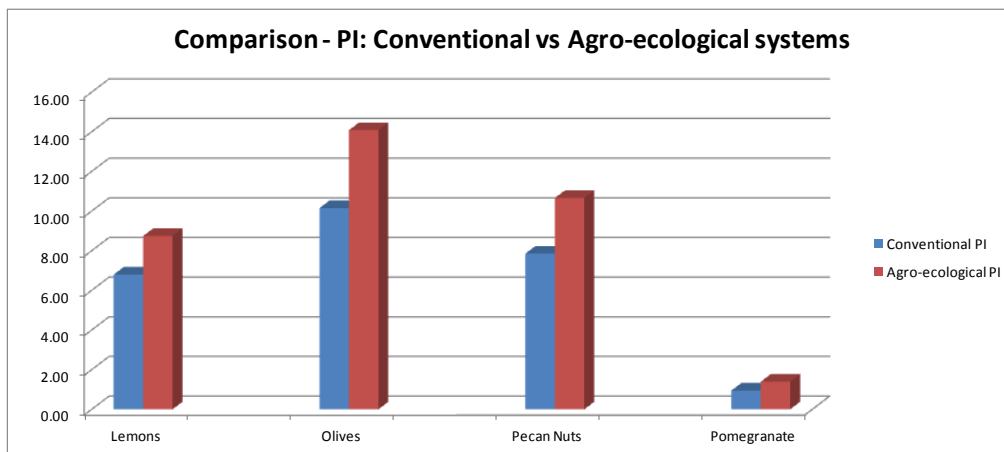


Figure 2.13: Comparison - PI: Conventional vs Agro-ecological systems

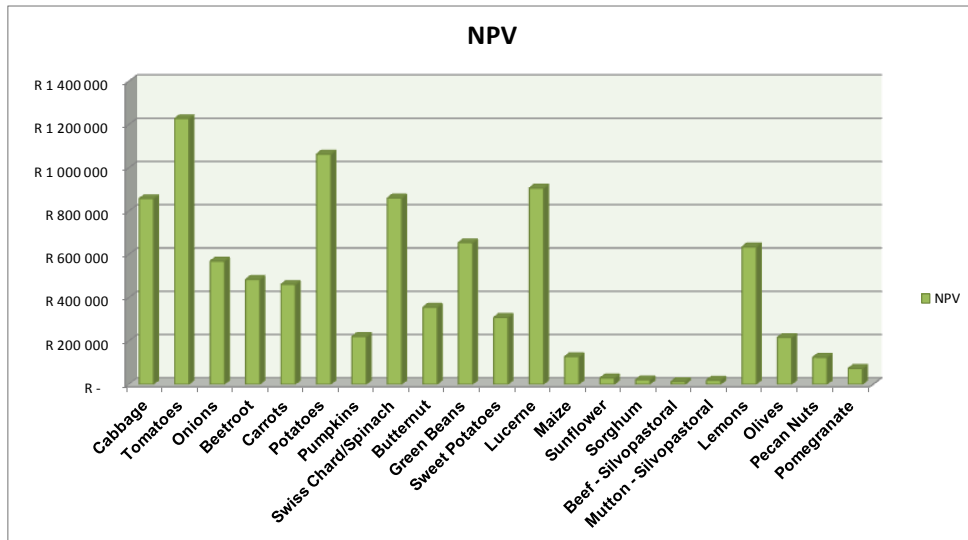


Figure 2.14: Comparison of the NPV of sustainable agricultural practices

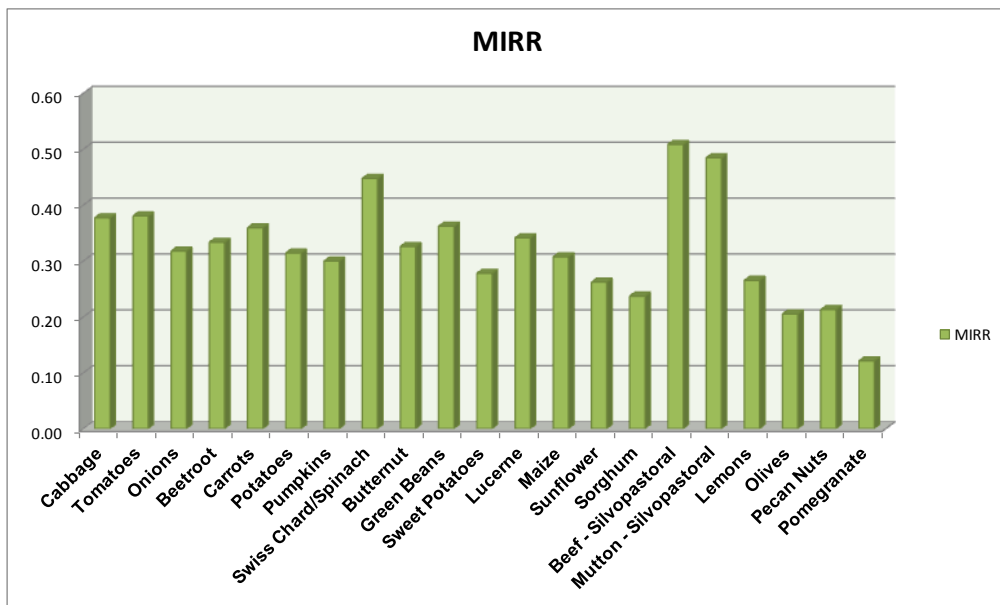


Figure 2.15: Comparison of the MIRR of sustainable agricultural practices'

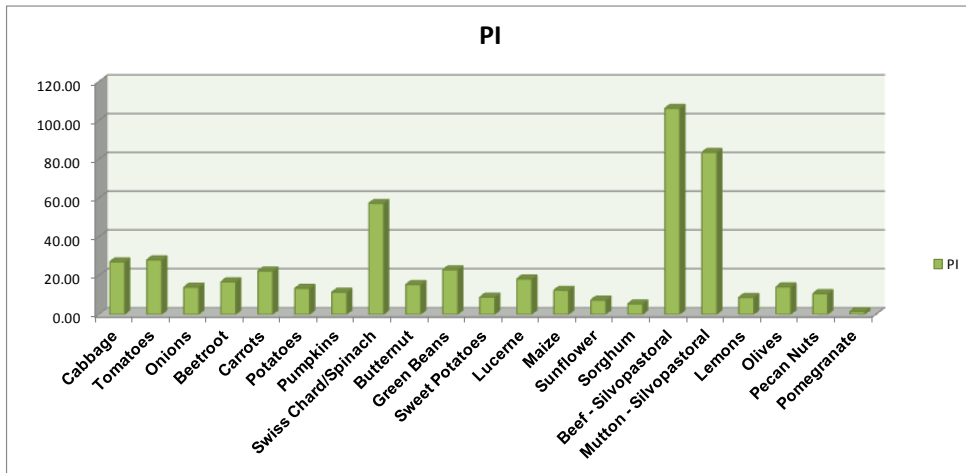


Figure 2.16: Comparison of the PI of sustainable agricultural practices'

Sensitivity Analysis													
Conventional NPV		-25	-20	-15	-10	-5	SAP NPV	+5	+10	+15	+20	+25	
1	Cabbage	R 333 360	R 307 273	R 322 637	R 348 243	R 368 728	R 389 213	R 409 698	R 430 183	R 450 668	R 471 152	R 491 637	R 512 122
2	Tomatoes	R 412 782	R 440 761	R 470 145	R 499 529	R 528 913	R 558 297	R 587 681	R 617 065	R 646 449	R 675 834	R 705 218	R 734 602
3	Onions	R 149 245	R 192 002	R 204 802	R 217 602	R 230 402	R 243 202	R 256 002	R 268 802	R 281 602	R 294 403	R 307 203	R 320 003
4	Beetroot	R 138 882	R 166 966	R 178 097	R 189 228	R 200 359	R 211 490	R 222 621	R 233 752	R 244 883	R 256 014	R 267 145	R 278 276
5	Carrots	R 146 447	R 163 099	R 173 972	R 184 845	R 195 719	R 206 592	R 217 465	R 228 338	R 239 212	R 250 085	R 260 958	R 271 831
6	Potatoes	R 272 775	R 357 216	R 381 030	R 404 845	R 428 659	R 452 473	R 476 288	R 500 102	R 523 916	R 547 731	R 571 545	R 595 360
7	Pumpkins	R 50 374	R 72 218	R 77 033	R 81 847	R 86 662	R 91 476	R 96 291	R 101 106	R 105 920	R 110 735	R 115 549	R 120 364
8	Swiss Chard/Spinach	R 321 107	R 318 241	R 339 457	R 360 674	R 381 890	R 403 106	R 424 322	R 445 538	R 466 754	R 487 970	R 509 186	R 530 402
9	Butternut	R 98 043	R 121 407	R 129 501	R 137 595	R 145 688	R 153 782	R 161 876	R 169 970	R 178 064	R 186 157	R 194 251	R 202 345
10	Green Beans	R 209 312	R 231 699	R 247 145	R 262 592	R 278 039	R 293 485	R 308 932	R 324 378	R 339 825	R 355 272	R 370 718	R 386 165
11	Sweet Potatoes	R 54 134	R 96 477	R 102 909	R 109 341	R 115 772	R 122 204	R 128 636	R 135 068	R 141 500	R 147 931	R 154 363	R 160 795
12	Lucerne	R 254 826	R 310 565	R 331 270	R 351 974	R 372 678	R 393 383	R 414 087	R 434 791	R 455 496	R 476 200	R 496 904	R 517 609
13	Maize	R 42 522	R 41 505	R 44 272	R 47 039	R 49 806	R 52 573	R 55 340	R 58 107	R 60 874	R 63 641	R 66 407	R 69 174
14	Sunflower	R 4 814	R 8 244	R 8 793	R 9 343	R 9 893	R 10 442	R 10 992	R 11 541	R 12 091	R 12 641	R 13 190	R 13 740
15	Sorghum	R 4 198	R 5 110	R 5 450	R 5 791	R 6 132	R 6 472	R 6 813	R 7 154	R 7 494	R 7 835	R 8 176	R 8 516
16	Beef - Silvopastoral	R 3 814	R 6 693	R 7 139	R 7 586	R 8 032	R 8 478	R 8 924	R 9 371	R 9 817	R 10 263	R 10 709	R 11 155
17	Mutton - Silvopastoral	R 9 279	R 19 384	R 20 676	R 21 969	R 23 261	R 24 553	R 25 845	R 27 138	R 28 430	R 29 722	R 31 014	R 32 307
18	Lemons	R 545 177	R 476 031	R 507 766	R 539 502	R 571 237	R 602 972	R 634 708	R 666 443	R 698 179	R 729 914	R 761 649	R 793 385
19	Olives	R 172 290	R 162 044	R 172 847	R 183 650	R 194 453	R 205 256	R 216 059	R 226 862	R 237 665	R 248 467	R 259 270	R 270 073
20	Pecan Nuts	R 101 409	R 93 428	R 99 656	R 105 885	R 112 113	R 118 342	R 124 570	R 130 799	R 137 027	R 143 256	R 149 484	R 155 713
21	Pomegranate	R 50 843	R 54 882	R 58 540	R 62 199	R 65 858	R 69 517	R 73 175	R 76 834	R 80 493	R 84 152	R 87 811	R 91 469

Table 1.16: Sensitivity Analysis

4.2.3 Conclusion

From the above data, it is clear that sustainable agricultural practices compare very favourably with the same conventional agricultural systems due to lower input costs and higher yields. The sensitivity analyses also indicate that implementing sustainable agricultural practices makes for fairly robust practices as most enterprises can beat the conventional methods, even if the former is 15 - 25% less successful than anticipated.

4.3 Barriers to the uptake of sustainable agricultural practices

4.3.1 Literature Review

4.3.1.1. Possible barriers and potential keystones

The ways and means to facilitate the implementation of more sustainable agricultural systems on farm and field level have effectively been tested and recorded in the past ten years (Pretty, 2008:460).

The concept of the healthy interaction between the five renewable capitals of ecological, social, financial, intellectual and human assets and the resulting increase in agricultural production as well as the flow of environmental goods and services have been proven and widely accepted (Pretty, 2008:460).

In spite of this definite progress, the uptake of sustainable agricultural practices as preferred method of attaining food security has been slower than wished for, apparently due to a lack of supportive governmental policies and input (Pretty, 2008:460).

This viewpoint is supported by Gbetibouo (2009:28), Smit (2002:102) and Twyman (2007:308). According to these authors, some external support is needed to initiate and facilitate the adoption of sustainable agricultural practices.

Some of the more important barriers noted by Rodriguez et al (2008:66) during their study in the USA, which is supposedly the world leader in sustainable agricultural practices are following:

- The costs of “changing from one management style to another”;
- “the fear of the unknown awaiting after the changeover to sustainable agricultural practices”;
- “a lack of governmental incentives for sustainable farming”;
- “a lack of knowledge and education” as well as
- “a perceived decline in yields”.

In his study, Du Toit (2007:4) indicated that the respondents felt that the unavailability of location-specific information on sustainable agricultural practices constituted a definite barrier to the uptake of more sustainable practices.

Hidden risks and uncertainties involved in changing their production system were also listed as barriers by 73% of the abovementioned participants (Du Toit, 2007:25).

A shortage of extension services (reliable knowledge and information) as well as lack of credit facilities were listed by Gbetibouo (2009:28) in a study conducted in the Limpopo River basin that included the area of the MBR.

According to a study conducted in Canada the financial management decisions on farm level to migrate to sustainable agricultural practices are significantly shaped by the availability or lack of governmental agricultural support and incentive programs (Smit, 2002:102).

According to Stallman & Harvey (2016:23) little evidence was found that trust 'as an individual construct determines' the willingness of farmers to cooperate in collective projects

Other determinants such as shared apprehension for the depletion of the ecological capital, perceived benefits of working together and the respondents' preference for rather taking on risk as a group, are more important than trust as such in this milieu (Stallman & Harvey, 2016:23).

According to Thierfelder, et al. (2014:342) the following are some of the more vital aspects that must be addressed to enhance the uptake of sustainable agricultural practices:

- Conservation Agriculture 'is not a 'one-size-fits-all' solution and often needs considerable adjustments and agility when implementing it on field and farm level.
- The perceptions of farmers about sustainable agricultural practices.

- The financial limitations experienced by individuals on farm level.
- Inadequate market access for the products of sustainable agricultural practices.

4.3.1.2. The Survey process

With these examples from the literature as background, a draft research design was compiled. It was then evaluated by a small number of farmers from the management teams of the four agricultural associations in the region of the MBR to test the content and face validity.

These discussions formed the basis for the pilot questionnaire which was then tested by two small groups of farmers from the area. The survey was refined according to their input and sent to the target group of farmers residing in the buffer areas of the MBR via SurveyMonkey.com.

A total of 24 questionnaires of the 186 that were dispatched were received digitally (12.9%) within the stipulated time frame. To augment this return, the Stakeholder Engagement Specialists from the Marico River Conservation Association collected a further 26 responses through door to door visits in the area with hard copies of the questionnaire, bringing the total sample to 26.88% of the targeted population.

The latter data was also digitised. A statistical analysis was done to test the construct validity and reliability of the internal consistency, resulting in the data as given below: (See appendix B for the detail of the constructs)

Construct	Number of sub constructs (Sub Questions)	Cronbach's Alpha	Split-Half (odd-even) Correlation	Split-Half with Spearman-Brown Adjustment	Mean	Standard Deviation
Knowledge about SAP	14	0.978	0.991	0.995	59.380	12.635
Barriers to SAP	7	0.963	0.966	0.983	21.816	5.868
Keystones for greater uptake of SAP	6	0.949	0.962	0.981	23.06	6.589

Table 1.17: Internal reliability of the data

Although the values obtained is fairly high, it must be indicated that Cronbach's alpha is necessarily higher for tests measuring narrower constructs.

The results were first described and then analysed with the aim of devising executable actions that will lead to the demise of the identified barriers over time as well as the integration of the potential keystones for enhanced migration to sustainable agricultural practices into the MBR management processes.

The results and proposed actions from the survey where afterwards shared with 6 farmers from the management teams of the four agricultural associations in the region of the MBR to deliberate on the results obtained and refine the actions to be taken to enhance the uptake of sustainable agricultural practices in the biosphere reserve region.

4.3.2 Results

The following results were obtained and the actions to be taken to enhance the uptake of sustainable agricultural practices in the biosphere reserve region subsequently defined as indicated below: (Own Source)

	Fact	Deduction	Actions to be taken
1.	Only 20% of the respondents are younger than 41, while only 18% are between 40 and 50 years of age.	Due to their relatively small percentage of the total and their possible perceived lack of experience, it will currently be difficult for this group to shape the perceptions about sustainable agricultural practices in the area.	As this group will need to drive the future of sustainable agricultural practices in the area, they must be a priority focus group to enhance their knowledge, skills and mindset with regard to sustainable agricultural practices. They must be mobilised as change agents toward more sustainable practices in the region.
2.	The remaining 62% of the respondents are older than 50 with the bulk (40%) older than 55.	This group are highly experienced farmers with a huge knowledge base, but due to their age, set ways and large numbers, redirecting their mind-set may be harder than initially anticipated.	The advantages of sustainable agricultural practices must be shown in such a way that the buy in of this segment of the population is ensured. The need for their experience must also be stressed and the latter incorporated in the overall sustainable agricultural practices strategy.
3.	The vast majority (86%) of the respondents are men with only 14% women.	Although the women are outnumbered, the percentage is much bigger than expected. As the women are more likely to be the primary caregiver in the family, they are probably more susceptible to the concept of long term sustainability.	This group must also be cultivated and mobilised as part of the agents for change towards more sustainable practices in the region.
4.	Of the respondents, more than 66% have 20 years or more of farming experience with at least 1173.5 years of experience locked up in the group of respondents alone.	The area specific challenges and their solutions are well known.	This treasure of knowledge must be harnessed and utilised to its fullest extend by using the existing capabilities in the region to address the new challenges successfully.

	Fact	Deduction	Actions to be taken
5.	Almost two thirds or the respondents (58%) have full title deed of their land.	The group with full title deed may utilise their land as collateral for funding to migrate to more sustainable agricultural practices if necessary. The rest of the group without full title deed will probably need other methods of financing and will probably find it more difficult to migrate to more sustainable agricultural practices.	Innovative alternatives for funding must be developed to ensure a bigger uptake of sustainable agricultural practices in the short term.
6.	The area covered by ownership of the respondents adds up to 38 307 ha or 22.8% of the targeted buffer areas of the MBR. This correlates reasonably with the size of the sample namely 26.88%. The mean of the sample is 781.79 ha.	Although the mean indicates sizable portions of land, the area is still fairly fragmented in terms of ownership. This implicates a huge number of landowners to deal with during the implementation of the SAMF and accentuates the importance of coordinating the sustainable agricultural practices on landscape and regional level to optimise the efforts on individual field and farm level.	A properly designed change management process must be designed and implemented to focus and harness the potential of all the aforementioned landowners towards building the ecological capital of the region.
7.	At least 74% of the respondents are full time farmers and the rest part-time, meaning they have another (primary) means of income.	Three quarters of the target group are available during the week while the rest will probably only be available during weekends. The latter has some other income, so they may initially be more susceptible to implementing sustainable agri-practices as they are not completely dependent on farm income.	Although a certain amount of interaction between these two segments is needed, addressing them as two different focus groups must be seriously considered as they form distinct groups that are easily identifiable and measurable, are accessible to specific marketing efforts and respond to these efforts in a distinguishable way.

	Fact	Deduction	Actions to be taken
8.	Almost 40% of the respondents are involved with livestock farming, 10.34% with horticulture, 13.79% with dry land cash crops, 11.49% with irrigated cash crops, 12.64% with game, 12.64% with tourism and 1.15% with dairy produce.	Mixed production systems are the norm in the area with livestock farming currently being the biggest component.	The approach taken towards obtaining buy in from the landowners in terms of building the ecological capital of the region must include all these identified agricultural enterprises.
9.	Ninety eight percent of the respondents either agreed or agreed strongly with the definition of sustainable agricultural practices supplied.	The one respondent who was uncertain may have been struggling with the language as the survey was done in Afrikaans.	In order to better internalise the sustainable agricultural practices concept, a slogan must be devised to describe the core elements of the concept concisely.
10.	More than 90% of the respondents agreed or strongly agreed with the importance of preserving and enhancing the ecological capital of the region, the need for decreasing pollution and the significance of increasing the production of the region.	From the results it is apparent that the need to change is already fairly well established in the minds of the majority of participants and that the necessity to build up the ecological capital of the region is clearly recognised by all.	This reality must be strengthened further and build upon through awareness actions and knowledge dissemination throughout the region.
11.	Between 85% and 90% of the respondents rated the improvement of soil quality, the strengthening of ecosystem services and the mitigation of climate change's impact as well as the utilisation of farm level knowledge as important or extremely important.	It is evident from the findings that the respondents are reasonably certain of the more obvious actions that must be taken to enhance the ecological capital of the region.	This foundation must be extended through awareness and the dissemination of more detailed information to all identified focus groups within the MBR.
12.	Eighty three percent of the participants acknowledged the significance of sustainable agricultural practices' ability to lower input costs and increase the yield of most agricultural enterprises.	The increase of yields and the decrease of input costs are two of the stronger drivers to enhance the migration to sustainable agricultural practices	Over and above the aforementioned dissemination of the applicable information, practical examples of these drivers must be communicated and shown to all stakeholders.

	Fact	Deduction	Actions to be taken
13.	The need to decrease the utilisation of fossil fuels was seen as important or very important by 73.47% of the respondents.	The decrease in the utilisation of fossil fuels also impacts positively on the production cost of most agri-practices.	The cost savings possible through the decrease in fossil fuel use must also be stressed during awareness actions.
14.	A bit less than two thirds of the participants (63.26%) realised that sustainable agricultural practices will increase the value of their land over time while only 60.41% felt that it is important to enhance the carbon balance in the world.	The increase of the land value over time is one of the more robust drivers to enhance the migration to sustainable agricultural practices, while the role of agriculture in upsetting the carbon balance need to be well comprehended in order to combat the latter and pave the way for carbon sequestration and the accompanying trade in carbon credits which can be another strong driver towards the adoption of sustainable agricultural practices.	The reality of the increase of the land value over time needs to be made visible to the target group in the MBR to strengthen their resolve to migrate to sustainable agricultural practices. The general knowledge with regard to the carbon balance and the advantages of carbon sequestration for the annual profit and loss statement should be increased as part of the planned capacity building programme for landowners.
15.	Between 81.25% and 85.72% of the participants rated the cost of capital and the uncertainty of implementing new systems as the most important barriers to migrating to more sustainable agri-practices.	As it is difficult for the individual to influence the availability and cost of capital the fact that this is seen as the most significant barrier is perfectly understandable. Although the internet may provide many self-help ideas in terms of sustainable agricultural practices, the lack of scientific backing increases the uncertainty instead of allaying it.	Innovative alternatives for funding must be developed to ensure a bigger uptake of sustainable agricultural practices in the short term while physical examples of successful sustainable agricultural practices' must be incorporated into the awareness and capacity building interventions.

	Fact	Deduction	Actions to be taken
16.	Insufficient knowledge, lack of trust between farmers and the risks of adopting new techniques were listed by respectively 75.51% for the first two matters and 73.47% of the respondents for the last concern as the next most significant barriers to adoption of sustainable agricultural practices.	The unknown always increases the perceived risks inherent to a new course of action and often prevent people from trying novel ideas. This may also impact negatively on the existing shortage of trust that everyone will do his/her part to enhance the ecological capital on landscape and regional level.	These barriers must be addressed through awareness and the dissemination of more detailed knowledge and information to all identified focus groups within the MBR. A specific and detailed action plan for increasing trust between all role players must be instituted to enhance the concept of interdependence within the biosphere reserve. The shared apprehension for the depletion of the ecological capital, perceived benefits of working together and the respondents' preference for taking on risk as a group rather than as individuals must be utilised to bridge the sense of a lack of trust between farmers.
17.	Lower yields were also indicated by 70.83% of the participants as barriers to the uptake of sustainable agricultural practices while 65.31% indicated that the long-term nature of transforming to sustainable agricultural practices is seen as a stumbling block for taking the leap to more sustainable production systems.	The perception of lower yields has been rejected by many scientific studies. Although transforming to sustainable agricultural practices takes time, it must be weighed against the alternative of losing all ecological capital over time.	Awareness and the distribution of more detailed knowledge, information and practical real live examples must stress the benefits of higher yields and lower input costs that lead to increased net farm income over time.

	Fact	Deduction	Actions to be taken
18.	<p>Training in sustainable agricultural practices was seen as the primary key stone by 96% of the respondents while 85.72% indicated that the second key stone for the better uptake of more sustainable systems will be a ready supply of affordable capital. Increase market access was identified by 71.43% of the participants as the third key to amplifying the ecological capital of the region through the enhanced uptake of sustainable agricultural practices.</p>	<p>It is apparent that the need for sustainable agricultural practices' training is already well established in the minds of the participants and that the necessity to increase market access is duly recognised as well by a solid majority. As the individual is normally struggling to positively influence the availability and cost of capital the need for a better dispensation in this regard is obvious.</p>	<p>The planning, organising and implementation of sustainable agricultural practices training programs must be first priority within the management processes of the MBR, followed by a determined drive towards the attainment of collective accreditation as GLOBAL GAP producers to enhance market access. This must be coupled to the development of the MBR brand to both increase the quality of products flowing from the biosphere reserve and the ease of negotiating better prices for these products. These actions must also be complemented with the development of innovative alternatives for funding to ensure a bigger uptake of sustainable agricultural practices in the short, medium and long term.</p>

Table 1.18: Survey results

To translate the abovementioned actions into a breakthrough accomplishment it must be structured into an effective and efficient implementable action plan. To this effect, the ten principle model of change (Jackson, 2016:6) will be utilised.

The employment of this ‘ten principle change management model’ is an integrative, multi-dimensional and holistic process to manage change effectively while translating plans into efficient actions and not a series of chronological steps (Jackson, 2016:8).

Principle Number	Principle	Focus	Benchmark for the successful implementation of the principle
1.	Identify the Purpose (s) of the change.	Aim of the SAMF.	The stakeholders are able to identify with and commit to the end results because they are capable of describing and understanding the purpose of the SAMF and the reasons for change.
2.	Clarify the need for change.	The realisation of the SAMF’s aim must represent a newly minted asset to the stakeholders and the region.	Assets that will eventually result from the process are identified. Results are being seen as an asset. The stakeholders’ question of “what’s in it for me” is resolved. Agreement on the purpose is obtained (principle 1).
3.	Ensure Leadership /Stakeholder Involvement.	Leadership and stakeholder involvement must be established as soon as the need for change and the purpose of the plan are clear as successful change needs both effective leadership and efficient management. The different focus groups as identified during the analysis of the survey results must be involved from step 1.	The extent to which leaders and stakeholders are involved. Commitment to the vision, goals and value system is created and aligned. Direction and purpose are ascertained. An appealing and encouraging climate that is beneficial to change is established.

Principle Number	Principle	Focus	Benchmark for the successful implementation of the principle
4.	The Diagnostic Principle.	In order to create the new asset, an in-depth diagnosis must be conducted to identify what current positives can be capitalised upon and which contemporary negatives are present within the situation that must be removed or managed. To monitor and evaluate the ultimate outcome of the change programme norms and principle must be established while identified issues must be categorised as problems, conflicts or polarities.	The following are identified and analysed: <ul style="list-style-type: none"> • Type of change to be implemented – transformational or reformational or both. • The inherent assets and liabilities of the situation. • The appropriateness of the indicative information as a take-off point for interventions. • The reliability and validity of the diagnosis.
5.	Distinguish between Problems & Dilemmas.	To focus the change management intervention, it is essential to differentiate between solvable problems and dilemmas or polarities that can and should only be managed on the journey to achieve the purpose.	The differentiation between problems and polarities as well as the timely and sufficient application of problem solving techniques and polarity management methods to realise the terminal outcome.
6.	Develop a Results-Orientated Change Strategy.	This results-orientated change strategy integrates the purpose of the plan (principle 1) and the confirmed need(s) for change (principle 2) while inspiring uninterrupted leadership and stakeholder involvement (principle 3). These aforementioned actions build on the inherent assets of the situation (principle 4) to resolve the identified problems and manage the established polarities or dilemmas (principle 5).	The particular strategic tools chosen can realise the required outcomes, were identified during the diagnosis and are lined up with the need for leadership and stakeholder participation. Principles 5, 8 and 9 were also considered during the selection of the applicable tools.
7.	Create Aligned-Commitment.	The equation of Aligned Commitment = Knowledge x Information x Rewards and Recognition x Empowerment x Shared Vision is applied.	All five elements of aligned commitment are applied and Laozi's narrative of " <i>When the best leader's work is done – the people say we did it ourselves</i> " is realised. P 34.

Principle Number	Principle	Focus	Benchmark for the successful implementation of the principle
8.	Manage Apathy to Change.	Indifference and opposition to change are identified and managed proactively through adjusting and reacting to change in time.	The successful recognition of the sources and reasons for, as well as the nature of resistance to the needed change, followed by the application of the applicable resistance management strategies.
9.	Create a Learning Culture.	Change proficiency is a requirement for imminent survival and growth that rests at least on the accepting and living of new values and at the worst on a change in organisational/group culture. This dictates the creation and maintenance of a learning culture that strongly supports change proficiency.	The culture and attitude to change are embedded in the stakeholders.
10.	Monitor & Evaluate Progress and Results.	Monitoring and the evaluation of progress are predominantly employed as important inputs during the execution of all actions to realise the other nine principles.	The magnitude to which the purpose(s) of the plan or change (principle 1) has been realized and the magnitude to which a new asset (principle 2) has been created as well as the degree to which diagnosed problems and dilemmas (principle 4) have been solved/ are successfully managed.

Table 1.19: Ten principle change management model

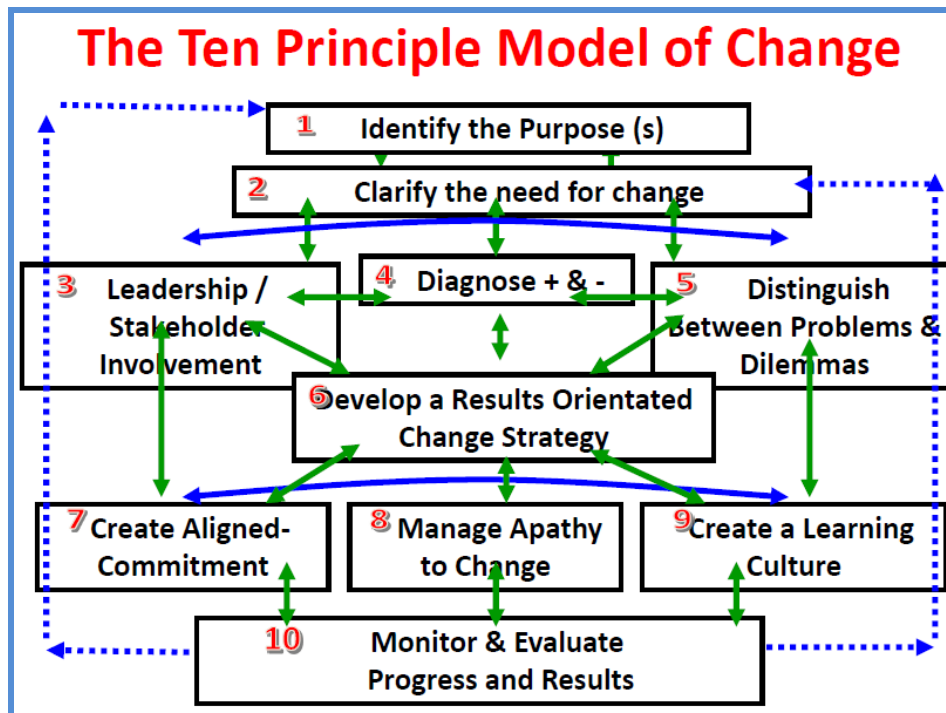


Figure 2.17: Ten Principle Model of Change

4.3.3 Possible Barriers and Potential Keystones: Conclusions

From the results obtained and the analyses thereof it is resolved that the planning, organising and implementation of sustainable agricultural practices training programs must be first priority within the management processes of the MBR.

This must be followed by a determined drive towards the attainment of collective accreditation as GLOBAL GAP producers to enhance market access and must be coupled to the development of the MBR brand to both increase the quality of products flowing from the biosphere reserve and the ease of negotiating better prices for these products.

These actions must also be complemented with the development of innovative alternatives for funding and the implementation of the 'ten principle change management model' to ensure a bigger uptake of sustainable agricultural practices in the short, medium and long term.

4.4 Conclusions and recommendations: Article 2

From the study it is clear that the question of “what’s in it for me” can be answered with the assurance that sustainable agricultural practices lead to lower input cost and higher yields, which result in positive net present values, MIRR and PI for the farmer.

As training was seen as the primary key stone for an increased uptake of sustainable agricultural practices by 96% of the respondents, the mind-set to undo the previously internalised knowledge and skills and replace it with a brand-new approach, an innovative information base and up-to-the-minute agricultural proficiency seems to be present in the MBR.

The third concern of uncertainty may be countered by translating the listed actions into a breakthrough accomplishment by utilising the ten principle model of change (Jackson, 2016:8) while the need for increased market access can be dealt with through a determined drive towards the attainment of collective accreditation as GLOBAL GAP producers and the optimising of the MBR brand.

Given the comprehensive nature of devising a ready supply of affordable capital to address the need for funds to bridge the transformation and opportunity costs that come with the bigger uptake of sustainable agricultural practices in the short, medium and long term, it necessitates an independent study of its own.

Chapter 5: Conclusion and recommendations.

Conclusions

From the previous chapters the following conclusions may be articulated:

- The fusion of the biosphere reserve concept as governance structure with the prerequisites of sustainable agricultural practices on field, farm and landscape as well as biosphere reserve level provides a sustainable multi-level agricultural management framework that may multiply the resilience and sustainability innovation of individual interventions and create integrated value for the region, its people and society at large.
- This sustainable multi-level agricultural management framework may enhance the human, social and intellectual capital of the region
- The financial feasibility of sustainable agricultural practices compares exceptionally well with that of conventional agricultural systems.
- The main barriers preventing or delaying the migration to sustainable agricultural practices by the landowners in the region were resolved to be the cost of capital, insufficient knowledge of sustainable agricultural practices and the uncertainty of implementing new systems.
- In line with the abovementioned barriers the landowners identified training in sustainable agricultural practices, a ready supply of affordable capital and increased market access as the keystones for the intensifying of sustainable agricultural practices.

Recommendations

In order to ease the implementation of the devised SAMF, the following research needs to be done:

- What impact will the implementation of these sustainable agricultural practices have on the value of agricultural land in the area?
- The development of innovative alternatives for devising a ready supply of affordable capital to address the need to bridge the transformation and opportunity costs that come with the bigger uptake of sustainable agricultural practices in the short, medium and long term.

• ANNEXURE A: REFERENCES

Altieri, M. & Nicholls, C. 2004. Biodiversity and pest management in agroecosystems. New York: Food Product Press.

Altieri, M. & Rosset, P. 1996. Agroecology and the Conversion of large scale conventional systems to sustainable management. *Environmental Studies*, Vol 50: 165-185.

Association for Temperate Agroforestry, 2017. Temperate Agroforestry. [Online] Available at: <http://www.aftaweb.org/about/what-is-agroforestry.html> [Accessed 3 September 2017].

Baudry, J., Burel, F., Thenail, C. & Le Coeur, D. 2000. A holistic landscape ecological study of the interactions between farming activities and ecological patterns in Brittany, France. *Landscape and Urban Planning*, 50(3):119–128.

Birkhofer, K., Bezemer, T.M., Bloem, J., Bonkowski, M., Christensen, S., Dubois, D., Ekelund, F., Fliesbach, A., Gunst, L., Hedlund, K., Mäder, P., Mikola, J., Robin, C., Setälä, H., Tatin-Froux, F., Van der Putten, W.H. & Scheu, S. 2008. Long-term organic farming fosters below and aboveground biota: implications for soil quality, biological control. *Soil Biology and Biochemicals*, 40:2297–2308.

Botha, L. 2017. SA Boer se waterslim plan trek wêreldwyd aandag. *Landbou Weekblad*, 24 March 2017:36-38.

Brigham, E. & Houston, J. 2009. Fundamentals of Financial Management. 12th ed. Mason: South-Western Cengage Learning.

Broom, D. M., Galindo, F. A. & Murgueitio, E. 2013. Sustainable, efficient livestock production with high biodiversity and good welfare for animals. *Proceedings of the Royal Society*, 280:2-9.

Business dictionary. 2017. *Business dictionary*. [Online]

Available at: <http://www.businessdictionary.com/definition/cooperative.html>

[Accessed 1 June 2017].

Cadman, M., Petersen, C., Driver, A., Sekhran, N., Maze, K. and Munzhedzi, S. 2010. Biodiversity for Development: South Africa's landscape approach to conserving biodiversity and promoting ecosystem resilience. South African National Biodiversity Institute, Pretoria.

Crafford, A.E., Ginsburg, K., Harris, D. & Mashimbye, A.E. 2010. Socio-Economic Assessment in support of the Reserve Determination study for the Crocodile (West) Marico Water Management Area. Pretoria: Zitholele Consulting and the Department of Water Affairs.

Crane, A., Palazzo, G., Spence, L.J., & Matten, D. 2014. Contesting the value of "shared value". *California Management Review*, 56(2):130 – 153.

Crane, A. & Matten, D. 2010. Business Ethics – Managing Corporate Citizenship and Sustainability in the Age of Globalization. New York: University Press.

Department of Environmental Affairs **see** South Africa.

Dodds, S. 1997. Towards a 'science of sustainability': Improving the way ecological economics understands human well-being. *Ecological Economics*, 23:95-111.

Du Toit, G. 2007. Promoting conservation agriculture in South Africa: A case study among commercial grain producers in the North West Province. Pretoria: The Bureau for Food and Agricultural Policy (BFAP).

Duffy, M. 2016. Questions. *Time*, 25 January 2016:12.

Dyllick, T. and Hockerts, K. 2002. Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, 35:130-141.

Ehrlich, P. & Ehrlich, A. 2012. Can a collapse of global civilization be avoided? *Proceedings of the Royal Society*, 7 December 2012:1-7.

Forest Europe. 2017. Silviculture. [Online]
Available at: <http://www.foresteurope.org>
[Accessed 3 September 2017].

Friedman, M. 1970. The Social Responsibility of Business is to Increase its Profits. *The New York Times Magazine*, 13 September 1970:5.

Gardiner, M., Fiedler, A., Costamagna, A. & Landis, D. 2009. Integrating conservation biological control into IPM systems. (In Radcliffe, E.B., ed. *Integrated pest management. Concepts, tactics, strategies and case studies*. Cambridge: Cambridge University Press. p. 151–162.

Gbetibouo, G. 2009. Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability - The Case of the Limpopo Basin, South Africa. Pretoria: International Food Policy Research Institute (IFPRI) Discussion Paper 00849.

German Commission for UNESCO. 2011. For life, for the future - Biosphere reserves and climate change a collection of good practice case studies. Bonn: UNESCO.

Global Footprint Network. 2012. Global Carrying Capacity. [Online]
Available at:
http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint/.
[Accessed 17 June 2017].

Hassan, R., Scholes, R. & Ash, N. 2005. *Ecosystems and Human Well-being: Current State and Trends*. Washington: Island Press.

Jackson, L. 2016. Change management and Organisational Development (OD): The Principles of Change. Potchefstroom: North-West University. [PowerPoint Presentation].

Kesavan, P.C. & Swaminathan, M.S. 2008. Strategies and models for agricultural sustainability in developing Asian countries. London: Royal Publishers.

Kotler, P. 2008. *Marketing Strategy*. [Online]
Available at: <https://www.youtube.com/watch?v=bilOOPuAvTY>
[Accessed 19 July 2016].

Lal, R. 2008. Carbon sequestration. *Sustainable Agriculture*, 363(1491):815-830.

Lipper, L., Thornton, P., Campbell, B.M., Baedeker, T., Braimoa, A., & Bwalya, M. 2014. Climate-smart agriculture for food security. *Nature Climate Change*, 26 November, 2014:1068 - 1072.

Lopes, C.M., Santos, T.P., Monteiro, A., Rodrigues, M.L.; Costa, J.M. & Chaves, M.M. 2011. Combining cover cropping with deficit irrigation in a Mediterranean low vigor vineyard. *Scientific Horticulture*, 129:603–612.

Malézieux, E., Crozat, Y., Dupraz, C., Laurans, M., Makowski, D., Ozier-Lafontaine, H., Rapidel, B., de Tourdonnet, S. & Valantin-Morison, M. 2009. Mixing plant species in cropping systems: concepts, tools and models - A review. *Agricultural Sustainable Development*, 29:43–62.

Malusá, E., Sas-Paszt, L. & Ciesielska, J. 2012. Technologies for beneficial micro-organisms inocula used as biofertilizers. *Scientific World Journal*, 4(9):239 -247.

Mbow, C., Neufeldt, H., Minang, P.A., Luedeling, E. & Kowero, G. 2014. Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion in Environmental Sustainability*, 6:8–14.

Meggison, W., Smart, S. & Graham, J. 2010. Financial Management. 3rd Ed. London: South-Western Cengage Learning.

Méndez, V., Bacon, C. & Cohen, R. 2013. Agroecology as a Transdisciplinary, Participatory, and Action-Oriented Approach. *Agroecology and Sustainable Food Systems*, 37:3-18.

Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and well-being. Washington, DC: Island Press.

MRCA (Marico River Conservation Association). 2017. Marico BR Abbreviated Management Plan. Groot Marico.

Natural Capital Coalition. 2017. Ecological Capital. [Online]
Available at: www.naturalcapitalcoalition.org
[Accessed 21 March 2017].

Norse, D., Ji, L., Leshan, J. & Zheng, Z. 2001. Environmental costs of rice production in China. Bethesda: Aileen Press.

Oxford Dictionary. 2017. [Online]
Available at: <https://en.oxforddictionaries.com/definition>
[Accessed 23 August 2017].

Phalan, B., Onial, M., Balmford, A. & Green, R. 2011. Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared. *SCIENCE*, 333(2):1289 - 1293.

Pretty, J. 2008. Agricultural Sustainability: Concepts, Principles and Evidence. *Philosophical Transactions: Biological Sciences, Sustainable Agriculture I*, 363 (1491):447-465.

Pretty, J., Noble, A., Bossio, D., Dixon, J., Hine, R. E., Penning de Vries, P. & Morison, J. I. L. 2006. Resource conserving agriculture increases yields in developing countries. *Environmental Science & Technology*, 40:1114-1119.

Programme on Man and the Biosphere. 2005. Biosphere Reserve Benefits & Opportunities. Paris: UNESCO.

Pywell, R.F., Heard, M.S., Woodcock, B.A., Hinsley, S., Ridding, L., Nowakowski, M. & Bullock, J.M. 2015. Wildlife-friendly farming increases crop yield: evidence for ecological intensification. *Proceedings of the Royal Society*, 282(9):243 - 256.

Ratnadass, A., Fernandes, P., Avelino, J. & Habib, R., 2012. Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: A Review. *Agro Sustainable Development*, 32:273–303.

READ. 2012. Agri Master Plan for the North West Province. Mahikeng: Rural, Environmental and Agricultural Development Department.

READ. 2015. North West Biodiversity Sector Plan 2015. Mahikeng: Rural, Environmental and Agricultural Development Department.

Regnault-Roger, C. & Philogène, B. 2008. Past and current prospects for the use of botanicals and plant allelochemicals in integrated pest management. *Pharmaceutical Biology*, 46:41–52.

Rigueiro-Rodríguez, A., McAdam, J. & Mosquera-Losada, M. 2009. Agroforestry in Europe - Current status and future prospects. Dordrecht: Springer.

Rodriguez, J.M., Molnar, J.J., Fazio, R.A., Sydnor, E. & Lowe, M.J. 2008. Barriers to adoption of sustainable agriculture practices: Change agent perspectives. *Renewable Agriculture and Food Systems*, 24(1):60–71.

Rumelt, R. 2012. Good Strategy, Bad Strategy. London: Profile Books Limited.

Scholberg, J.M.S., Dogliotti, S., Leoni, C., Cherr, C.M., Zotarelli, L. & Rossing, W.A.H. 2010. Cover crops for sustainable agrosystems in the Americas. (*In*: Lichtfouse, E., ed. Genetic engineering, biofertilisation, soil quality and organic farming. Dordrecht: Springer. p. 23–58).

Smit, B. and Skinner, M.W. 2002. Adaptation Options in Agriculture to Climate Change: A Typology. *Mitigation and Adaptation Strategies for Global Change*, 7:85–114.

Soane, B.D., Ball, B.C., Arvidsson, J., Basch, G., Moreno, F. & Roger-Estrade, J. 2012. No-till in Northern, Western and South-Western Europe: a review of problems and opportunities for crop production. *Soil Till Resolutions*, 118:66–87.

South Africa. Department of Environmental Affairs. 2013. Biodiversity Stewardship Programme. Pretoria.

South Africa. Department of Environmental Affairs. 2015. Discussion Document on Environmental Offsets. Pretoria.

Stallman, H. & Harvey, S. 2016. Farmers' Willingness to Cooperate in Ecosystem Service Provision: Does Trust Matter? *Annals of Public and Cooperative Economics*. 12 December, 2016:2-28.

Sutton, P.C., Anderson, S.J., Costanza, R. & Kubiszewski, I. 2016. The ecological economics of land degradation: Impacts on ecosystem. *Ecological Economics*, 129: 15 June 2016:182–192.

The International Integrated Reporting Council (IIRC). 2013. Integrated Value. [Online]. Available at: <https://www.theiirc.org>. [Accessed 25 June 2015].

The International IR Framework. 2013. Sustainability. [Online] Available at: <http://www.theiirc.org>. [Accessed 19 July 2016].

The World Bank. 2010. Convenient Solutions to an Inconvenient Truth - Ecosystem-Based Approaches to Climate Change. Washington DC.

Thierfelder, C., Mwila, M. & Rusinamhodzi, L. 2013. Conservation agriculture in eastern and southern provinces of Zambia: Long-term effects on soil quality and maize productivity. *Soil & Tillage Research*, 126:246–258.

Thierfelder, C., Rusinamhodzi, L., Ngwira, A.R., Mupangwa, W., Nyagumbo, I., Kassie, G.T. & Cairns, J.E. 2014. Conservation agriculture in Southern Africa: Advances in knowledge. *Renewable Agriculture and Food Systems*, 30(4):328–348.

Tilman, D., Cassman, K.G., Matson, P.A., Naylor, R. & Polasky, S. 2002. Agricultural sustainability and intensive production practices. *Nature*, 418:671-677.

Twyman, T., Twyman, C., David S.G., Osbahr, H. & Hewitson, B. 2007. Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change*, 83:301–322.

Visser, W. and Kymal, C. 2015. Creating Integrated Value: Beyond Corporate Social Responsibility (CSR) and Creating Shared Value (CSV). *Journal of International Business Ethics*, 8(1):29 - 30.

WEF. 2017. World Economic Forum. [Online]. Available at: <https://www.weforum.org/>. [Accessed 11 March 2017].

Wezel, A., Casagrande, M., Celette, F., Vian, J., Ferrer, A. & Peigné, J. 2013. Agroecological practices for sustainable agriculture. A review. *Agroecological practices for sustainable agriculture*, 30 September 2013:1–20.

Wiktionary. 2017. Landscape. [Online]. Available at: <https://en.wiktionary.org/wiki/landscape>. [Accessed 2 September 2017].

Worster, D. 1993. The wealth of nature: environmental history and the ecological imagination. New York: Oxford University Press.

Zebarth, B., Drury, C., Tremblay, N. & Cambouris, A. 2009. Opportunities for improved fertilizer nitrogen management in production of arable crops in eastern Canada: a review. *Canada Journal of Soil Science*, 89:113–132.

- **ANNEXURE B: EXAMPLE OF SURVEY**

**‘n Raamwerk vir Volhoubare Landbou in ‘n Biosfeer
Reservaat**

1. Doel van die Vraelys: Om te bepaal wat die implimentering van meer volhoubare landbou praktyke op plaasvlak bemoeilik.
2. Hierdie navorsing word deur Daan van der Merwe van die plaas Vergenoeg 289 JP (060 719 9959) gedoen as deel van 'n MBA kwalifikasie by NWU se Besigheidskool. Dit vind plaas onderleiding van Prof Ines Nel (018 299 1405). Dit sal waardeer word indien u 5 minute van u tyd sal afstaan om u unieke bydrae te lewer tot beter begrip rakende die implimentering van meer volhoubare landbou praktyke op plaasvlak. Terugvoering rakende die navorsing sal via die webwerf (www.maricobios.org) geskied.

3. Demografiese besonderhede:

a. Ouderdom: jaar.

b. Geslag: (Merk met 'n x asb?)

Manlik	1
Vroulik	2

c. Jare boerdery ondervinding:
.....

d. Eienaarskap van die plaas: (Merk met 'n x asb?)

Volle eienaarskap	1
Eenaar – Verband	2
Vennootskap	3
Huur	4
Ander (spesifiseer)	5

.....

e. Grootte van die plaas in ha:

.....

f. Soort boerdery: (Merk met 'n x asb?)

Kommersieël	1
Lewenstyl (Naweek boer)	2
Bestaansboerdery	3
Ander (spesifiseer)	4

.....

g. Hoof fokus van die boerdery:
(Merk elke vertakking met 'n x asb?)

Vertakking		% van Inkomste
Lewende Hawe	1	
Groente/Vrugte	2	
Saaiboerdery droë land	3	
Saaiboerdery besproeiing	4	
Wild	5	
Toerisme	6	
Suiwel	7	
Ander (spesifiseer)	8	

.....

4. Volhoubare landbou praktyke strewe na die verbetering van ekonomiese, ekologiese en menslik - sosiale kapitaal op die langtermyn.

Stem glad nie saam nie	
Stem nie heeltemal saam nie	
Onseker	
Stem saam	
Stem heelhartig saam.	

5. Die volgende kan gesien word as die belangrikste voordele van volhoubare landbou praktyke:

Voordeel	Onbelangrik	Effens Belangrik	Matig Belangrik	Belangrik	Baie Belangrik
Behoud van natuurlike hulpbronne					
Laer insetkoste					
Verbeterde ekosisteem dienste					
Verminder klimaatsverandering se impak					
Verbetering van grond kwaliteit					
Verhoging van produksie vermoë					
Verhoging van grond pryse					
Verbetering van koolstof balans					
Vermindering van fossiel brandstof					
Vermindering van besoedeling					
Verhoging van opbrengs					
Verbetering van natuurlike hulpbronne					
Maksimale benutting van plaasvlak kennis					
Ander:					

6. Faktore wat die implimentering van meer volhoubare landbou praktyke op plaasvlak bemoeilik:

Faktore wat bg implementering benadeel	Onbelangrik	Minder Nadelig	Meer Nadelig	Baie Nadelig
Bekostigbaarheid van kapitaal				
Onvoldoende kennis				
Onsekerheid				
Laer opbrengste				
Risikos				
Die feit dat omskakeling na meer volhoubare landbou praktyke 'n lang termyn aksie is				
Daar bestaan nie voldoende onderlinge vertroue tussen bure om saam ter werk aan meer volhoubare landbou praktyke nie				
Ander:				

7. Wat moet na u mening gedoen word om volhoubare landbou praktyk te bevorder?

Bevorderende faktore	Onbelangrik	Effens Belangrik	Matig Belangrik	Belangrik	Baie Belangrik
Opleiding					
Wetgewing					
Ontwikkeling van model plase					
Staatshulp - finansieel					
Staatshulp - landbou voorligting					
Beskikbaarmaking van bekostigbare kapitaal					
Ander:					

U deelname word waardeer – baie dankie!

ANNEXURE C: FINANCIAL DATA UTILISED

All amounts in ZAR per hectare

	WACC	0.1054										
	Re-invest Rate	0.1054										
Baseline: Conventional Agricultural Practices (ZAR per hectare)												
S nr	Crops	CF ₀	Year 1	Year 2	Year 3	Year 4	Year 5	NPV	MIRR	PI		
1	Cabbage	R -31 943	R 97 687	R 97 687	R 97 687	R 97 687	R 97 687	R 333 360	0.80	11.44		
2	Tomatoes	R -44 079	R 122 171	R 122 171	R 122 171	R 122 171	R 122 171	R 412 782	0.76	10.36		
3	Onions	R -41 374	R 50 974	R 50 974	R 50 974	R 50 974	R 50 974	R 149 245	0.50	4.61		
4	Beetroot	R -29 380	R 44 995	R 44 995	R 44 995	R 44 995	R 44 995	R 138 882	0.57	5.73		
5	Carrots	R -20 880	R 44 745	R 44 745	R 44 745	R 44 745	R 44 745	R 146 447	0.68	8.01		
6	Potatoes	R -80 523	R 94 477	R 94 477	R 94 477	R 94 477	R 94 477	R 272 775	0.49	4.39		
7	Pumpkins	R -19 742	R 18 750	R 18 750	R 18 750	R 18 750	R 18 750	R 50 374	0.42	3.55		
8	Swiss Chard/Spinach	R -15 095	R 89 905	R 89 905	R 89 905	R 89 905	R 89 905	R 321 107	1.06	22.27		
9	Butternut	R -23 498	R 32 502	R 32 502	R 32 502	R 32 502	R 32 502	R 98 043	0.54	5.17		
10	Green Beans	R -28 742	R 63 658	R 63 658	R 63 658	R 63 658	R 63 658	R 209 312	0.69	8.28		
11	Sweet Potatoes	R -35 919	R 24 081	R 24 081	R 24 081	R 24 081	R 24 081	R 54 134	0.33	2.51		
12	Lucerne	R -57 188	R 83 437	R 83 437	R 83 437	R 83 437	R 83 437	R 254 826	0.55	5.46		
13	Maize	R -10 518	R 14 184	R 14 184	R 14 184	R 14 184	R 14 184	R 42 522	0.53	5.04		
14	Sunflower	R -4 156	R 2 399	R 2 399	R 2 399	R 2 399	R 2 399	R 4 814	0.29	2.16		
15	Sorghum	R -4 440	R 2 310	R 2 310	R 2 310	R 2 310	R 2 310	R 4 198	0.26	1.95		

Table 1.20: Conventional Agri-Practices–Annual Crops

Range: Decrease in Production Costs in %		1	to	12								
Range: Increase in Yield (%)		14	to	34								
		Decrease in Production Cost		Increase in Yield								
		↓		0.12	↑		0.241					
Baseline: Conservation Agricultural Practices (ZAR per hectare)												
S nr	Crops	CF ₀	Year 1	Year 2	Year 3	Year 4	Year 5	NPV	MIRR	PI		
1	Cabbage	R -28 110	R 117 075	R 117 075	R 117 075	R 117 075	R 117 075	R 409 698	0.91	15.57		
2	Tomatoes	R -38 790	R 167 526	R 167 526	R 167 526	R 167 526	R 167 526	R 587 681	0.93	16.15		
3	Onions	R -36 409	R 78 194	R 78 194	R 78 194	R 78 194	R 78 194	R 256 002	0.68	8.03		
4	Beetroot	R -25 854	R 66 445	R 66 445	R 66 445	R 66 445	R 66 445	R 222 621	0.74	9.61		
5	Carrots	R -18 374	R 63 066	R 63 066	R 63 066	R 63 066	R 63 066	R 217 465	0.84	12.84		
6	Potatoes	R -70 861	R 146 314	R 146 314	R 146 314	R 146 314	R 146 314	R 476 288	0.66	7.72		
7	Pumpkins	R -17 373	R 30 395	R 30 395	R 30 395	R 30 395	R 30 395	R 96 291	0.61	6.54		
8	Swiss Chard/Spinach	R -13 284	R 117 021	R 117 021	R 117 021	R 117 021	R 117 021	R 424 322	1.22	32.94		
9	Butternut	R -20 679	R 48 817	R 48 817	R 48 817	R 48 817	R 48 817	R 161 876	0.71	8.83		
10	Green Beans	R -25 293	R 89 376	R 89 376	R 89 376	R 89 376	R 89 376	R 308 932	0.85	13.21		
11	Sweet Potatoes	R -31 609	R 42 851	R 42 851	R 42 851	R 42 851	R 42 851	R 128 636	0.53	5.07		
12	Lucerne	R -50 326	R 124 190	R 124 190	R 124 190	R 124 190	R 124 190	R 414 087	0.72	9.23		
13	Maize	R -10 484	R 17 602	R 17 602	R 17 602	R 17 602	R 17 602	R 55 340	0.60	6.28		
14	Sunflower	R -4 067	R 4 027	R 4 027	R 4 027	R 4 027	R 4 027	R 10 992	0.44	3.70		
15	Sorghum	R -3 907	R 2 867	R 2 867	R 2 867	R 2 867	R 2 867	R 6 813	0.35	2.74		

Table 1.21: Conservation Agri-Practices Annual Crops

WACC	0.1054																				
Re-invest Rate	0.1054																				
Conventional vs Sustainable Agricultural Practices (ZAR per hectare)																					
S nr	Enterprise	CF₀	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	NPV	MIRR	PI						
1	Beef - Conventional	-116	641	641	641	641	641	641	641	641	641	641	R 3 814	0.57	33.28						
2	Beef - Silvopastoral	-116	641	641	641	641	2 421	2 421	2 421	2 421	2 421	2 421	R 8 924	0.65	77.44						
3	Mutton - Conventional	-225	950	950	950	950	950	950	950	950	950	950	R 9 279	0.45	42.33						
4	Mutton - Silvopastoral	-225	950	950	950	950	3 711	3 711	3 711	3 711	3 711	3 711	R 25 845	0.61	116.12						

Table 1.22: Conventional vs Sustainable Livestock Practices

WACC	0.1054																				
Re-invest Rate	0.1054																				
Baseline: Conventional Agricultural Practices (ZAR per hectare)																					
S nr	Crops	CF₀	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	NPV	MIRR	PI	
1	Lemons	-82 639	-14 087	-1 859	31 896	72 720	118 647	118 647	118 647	118 647	118 647	118 647	118 647	118 647	118 647	118 647	118 647	R 545 177	0.24	6.80	
2	Olives	-17 310	-24 619	-30 287	-23 646	-5 056	17 903	63 982	63 982	63 982	63 982	63 982	63 982	63 982	63 982	63 982	63 982	R 172 290	0.19	10.15	
3	Pecan Nuts	-13 246	-6 435	-16 515	-7 507	-6 152	1 067	10 126	26 657	36 009	46 357	46 019	45 658	45 270	44 857	44 415	44 415	R 101 409	0.19	7.86	
4	Pomegranate	-68 169	-13 529	2 689	5 689	17 188	39 734	34 194	27 573	20 332	-68 169	-13 529	2 689	5 689	17 188	39 734	39 734	R 50 843	0.10	0.95	

Table 1.23: Conventional Agricultural Practices–Perennial Crops

WACC	0.1054																			
Re-invest Rate	0.1054																			
Baseline: Agro-ecological Practices (ZAR per hectare)																				
S nr	Crops	CF ₀	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	NPV	MIRR	PI
1	Lemons	-74 301	-12 666	-1 671	36 680	83 628	136 444	136 444	136 444	136 444	136 444	136 444	136 444	136 444	136 444	136 444	136 444	R 634 708	0.27	8.74
2	Olives	-15 563	-22 135	-27 231	-21 260	-4 545	20 589	73 580	73 580	73 580	73 580	73 580	73 580	73 580	73 580	73 580	73 580	R 216 059	0.21	14.08
3	Pecan Nuts	-11 910	-5 786	-14 849	-6 750	-5 531	1 227	11 645	30 656	41 410	53 311	52 922	52 507	52 061	51 586	51 077	51 077	R 124 570	0.21	10.66
4	Pomegranate	-61 291	-12 164	3 092	6 542	19 766	45 695	39 323	31 709	23 382	-61 291	-12 164	3 092	6 542	19 766	45 695	45 695	R 73 175	0.12	1.40

Table 1.24: Agro-ecological Practices–Perennial Crops

Mini-dissertation accepted in partial fulfilment of the requirements for the degree *Master of Business Administration* at the North-West University

Supervisor:

Prof I Nel

Graduation ceremony May 2018

Student number: 22829059