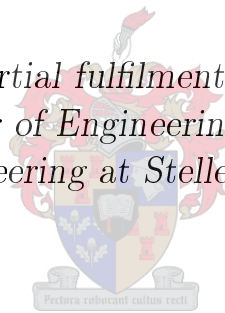


# A Methodology to Evaluate the Contribution of Small-Scale Farms to the Vision of Regulating Authorities

by

Phelia van Breda

*Thesis presented in partial fulfilment of the requirements for  
the degree of Master of Engineering Management in the  
Faculty of Engineering at Stellenbosch University*



Department of Industrial Engineering,  
University of Stellenbosch,  
Private Bag X1, Matieland 7602, South Africa.

Supervisors:

Supervisor: Prof. P.J. Vlok  
Co-supervisor: Dr. W.P. de Clercq

April 2014

# Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: ..... 2014/2/19 .....

Copyright © 2014 Stellenbosch University  
All rights reserved.

# Abstract

## A Methodology to Evaluate the Contribution of Small-Scale Farms to the Vision of Regulating Authorities

P. van Breda

*Department of Industrial Engineering,  
University of Stellenbosch,  
Private Bag X1, Matieland 7602, South Africa.*

Thesis: MEng (Engineering Management)

April 2014

South Africa's system of socio-economic development planning is complex and ineffective. There are many regulatory authorities involved, often with unclear responsibilities and inadequate procedures of implementing objectives. Planning for development in South Africa needs to take various factors into account. Economic growth is pursued, while social imbalances are addressed and the environment is protected against unreasonable damage. The term *Sustainable Development* is an important concept in the vision of many of the regulating authorities, however, the implementation of sustainability is difficult. This study considers an approach which aligns activities in a specified region to the vision and objectives of the applicable regulatory authorities, as an alternative to achieving objectives strictly through enforcing regulations.

This thesis developed an integrated evaluation model which can be used to evaluate the alignment of a small-scale farm to the visions and objectives of certain regulatory authorities. Four small-scale farms in the Letaba catchment of the Limpopo Province were used as a case study to be evaluated against national and regional development visions. On a national level the National Development Plan (NDP), the National Framework for Sustainable Development (NFSD), the Integrated Sustainable Rural Development Strategy (ISRDS) and the principles of Water Allocation Reform (WAR) were regarded. For regional categorisation, the relevant municipal Integrated Development Plan (IDP), Spatial Development Framework (SDF), Local Economic Development (LED) plan and the applicable Catchment Management Strat-

egy (CMS) were considered.

The Letaba catchment area has specific development constraints regarding water. For this reason, the impact the four farms have on the water of the region was evaluated in addition to their alignment with regional development visions. The hydrological evaluations were performed through the use of the Soil and Water Assessment Tool. Hereby it was determined whether objectives of development planning were realistic in terms of water availability. It was established that the location of a farm is a determining factor of the impact it has on the catchment area's water supply.

The developed Integrated Evaluation Model combined all the visions and objectives of the mentioned strategic documents to specifically assess the contribution a small-scale farm makes. The evaluation results provide insight into the alignment of activities to the ideals of a region and can be useful when formulating actions to reach a common vision. Small-scale farms are well-aligned to the objectives of WAR, the CMS and ISRDS. The farms have a limited contribution to the ideals of the NDP and NFSD and results against the IDP, the SDF and the LED differ considerably for each farm. Furthermore, the results of the farms' alignment with regional objectives do not correspond to the hydrologically ideal locations. Therefore, the development of small-scale farming should take hydrological information into consideration.

The Integrated Evaluation Model proves to be valuable, understandable and applicable to evaluate the alignment of small-scale farms to the visions of regulatory authorities.

# Uittreksel

## 'n Metodologie om die Bydrae van Kleinskaalboerdery tot die Visie van Regulatoriese Owerhede te Bepaal.

*(“A Methodology to Evaluate the Contribution of Small-Scale Farms to the Vision of Regulating Authorities”)*

P. van Breda

*Departement van Bedryfsingenieurswese,  
Universiteit van Stellenbosch,  
Privaatsak X1, Matieland 7602, Suid Afrika.*

Tesis: MIng (Ingenieursbestuur)

April 2014

Suid-Afrika se sisteem van beplanning vir sosio-ekonomiese ontwikkeling is ingewikkeld en oneffektief. Daar is verskillende regulatoriese owerhede betrokke wat maklik aanleiding gee tot onsekerheid ten opsigte van verantwoordelikhede asook tot onvoldoende benaderings tot implementering. Om ontwikkeling in Suid-Afrika suksesvol te laat geskied, moet verskeie faktore inaggeneem word. Behalwe vir die strewe na ekonomiese groei, moet sosiale agterstande gelyktydig aangespreek word en moet hierdie ontwikkeling van so 'n aard wees dat die omgewing nie onnodige skade lei nie. *Volhoubaarheid* is 'n gemeenskaplike ideaal van die meeste partye betrokke by die beplanning van Suid-Afrika se ontwikkeling. Die implementering van hierdie oogmerk is egter onduidelik. Hierdie studie oorweeg 'n benadering wat alle handeling in 'n bepaalde gebied in ooreenstemming bring met die visie en doelwitte van die toepaslike regulatoriese owerhede. Hierdie benadering word as 'n alternatiewe gestel teenoor 'n benadering om doelwitte slegs deur regulasies te bereik.

Hierdie tesis het 'n Geïntegreerde Evalueringsmodel ontwikkel wat die mate waartoe 'n klein plaas 'n bydrae maak tot die visie en doelwitte van regulatoriese owerhede meet. Vier kleinskaalse boerderye in die Letaba Opvangsgebied in Limpopo was ondersoek as 'n gevallestudie. Hierdie plase is geëvalueer teen nasionale- en streeksontwikkelingsvisies. Op 'n nasionale vlak is die Nasionale Ontwikkelings Plan (NOP), die Nasionale Raamwerk vir Volhoubare Ontwikkeling (NRVO), die Geïntegreerde Volhoubare Landelike Ontwikkelings Stra-

tegie (GVLOS) en die waardes van die Water Toekenning Hervorming (WTH) beskou. Ten opsigte van streeksontwikkeling, is die betrokke munisipale Geïntegreerde Ontwikkelings Plan (GOP), die Ruimtelike Ontwikkelings Raamwerk (ROR), Plaaslike Ekonomiese Ontwikkeling (PEO) plan en die gepaste Opvangsgebied Bestuurs Plan (OBP) inaggeneem.

Water is 'n beperkende faktor tot ontwikkeling in die Letaba opvangsgebied. Omrede, word die vier plase se impak op die watertoestand van die gebied bepaal, sowel as die bydrae tot die visie van die regulatoriese owerhede. 'n Opstelling van die studie-area is gemaak met die *Soil and Water Assessment Tool* ten einde hidrologiese afleidings te maak. Hierdeur is bepaal of die visies en doelwitte soos gestel deur die beplanningsdokumente vir ontwikkeling, realisties is ten opsigte van die waterbeskikbaarheid. Die studie het bevestig dat die ligging van 'n plaas 'n bepalende faktor is tot die plaas se uitwerking op die gebied se water.

Die ontwikkelde Geïntegreerde Evalueringsmodel kombineer die visies en doelwitte van die bogenoemde strategiese dokumente om die bydrae van 'n klein plaas te meet. Die evalueringsresultate verskaf insigte rondom die ooreenstemming van plase teenoor die visie van 'n streek en kan nuttig gepas kom wanneer spesifieke aksies beplan word om 'n gemeenskaplike doelwit te bereik. Kleinskaalse boerdery is in lyn met die doelwitte soos bepaal deur die OBP, GVLOS en WTH. Die bydrae wat die plase ten opsigte van die NOP en NRVO se ideale maak is egter beperk. Verder verskil die resultate grootliks vir elke plaas ten opsigte van die bydrae gelewer tot die visies van die GOP, ROR en PEO. Gewenste resultate ten opsigte van bydrae tot ontwikkelingsvisies het nie ooreengestem met die liggings wat aanbeveel is deur die hidrologiese studie nie. Dus moet hidrologiese inligting inaggeneem word tydens besluitneming vir die ontwikkeling van kleinskaalse boerdery.

Die Geïntegreerde Evalueringsmodel bied waarde, is toeganklik en is toepaslik om kleinskaalse boerdery te meet tenoor die visies van regulatoriese owerhede.

# Acknowledgements

I would like to express my sincere gratitude to the following people and organisations:

- Prof. P.J. Vlok, my supervisor, for valuable guidance, support and encouragement.
- Dr. W.P. de Clercq, my co-supervisor, for including me in the EAU4Food project, providing helpful advice and arranging financial assistance to support the research.
- Tanya Visser, who introduced me to this research opportunity and provided supervision in the early stages of my project.
- Dr. Tracy Baker for help with the developed SWAT model.
- Dr. Eric Querner and other researchers at Alterra, who provided guidance during my time in the Netherlands.
- The ARC for the provision of observed climate data.
- DWA for data on the reservoirs in the study area as well as streamflow information.
- Cou Pienaar and Tebogo Johannes for information on the farms involved in the study.
- YWP for the opportunity to present my research and gain feedback from other researchers in my field.

# Contents

<b>Declaration</b>	<b>i</b>
<b>Abstract</b>	<b>ii</b>
<b>Uittreksel</b>	<b>iv</b>
<b>Acknowledgements</b>	<b>vi</b>
<b>Contents</b>	<b>vii</b>
<b>List of Figures</b>	<b>xi</b>
<b>List of Tables</b>	<b>xiii</b>
<b>List of Acronyms</b>	<b>xiv</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Background . . . . .	1
1.1.1 Divided System of Planning, Implementation and Strategy	3
1.1.2 Activity Level Impacts . . . . .	4
1.1.3 Involve Strategic Planning Objectives in Decision-Making	5
1.1.4 An Alternative to the Regulatory Approach . . . . .	5
1.1.5 Potential Impact of Small-Scale Farming . . . . .	6
1.2 Problem Statement . . . . .	6
1.3 Research Objectives . . . . .	7
1.4 Research Questions . . . . .	9
1.5 Hypothesis . . . . .	10
1.6 Delimitation . . . . .	11
1.7 Methodology . . . . .	11
1.8 Document Structure . . . . .	12
1.9 Chapter Conclusion . . . . .	14
<b>2 Literature Review</b>	<b>15</b>
2.1 The System of Strategic Development Planning Documents . . . .	16
2.1.1 Background to Development and Environmental Functions	17



2.1.2	Environmental Legislation versus Development Visions . . . . .	17
2.1.3	Disagreements, Duplication and Disregarding of Tasks . . . . .	19
2.1.4	The Role of Water in Development and Environmental Management . . . . .	21
2.2	Sustainable Development in South Africa . . . . .	22
2.3	Implementing Vision at an Activity Level . . . . .	25
2.3.1	Aligning Activities with Regional Planning . . . . .	25
2.3.2	The Impact of Individual Activities on a Region . . . . .	26
2.4	Implementation Problems . . . . .	26
2.4.1	Capacity Issues . . . . .	27
2.4.2	Unclear Strategies . . . . .	27
2.4.3	Water Use Licences as an Example of Implementation Problems . . . . .	28
2.4.4	Compliance Issues . . . . .	30
2.4.5	Difficulty with Implementing Sustainable Development Ideals . . . . .	30
2.4.6	Unrealistic Visions . . . . .	31
2.5	Introduction to Small-Scale Farming in South Africa . . . . .	31
2.5.1	Opportunities and Benefits . . . . .	31
2.5.2	Constraints . . . . .	32
2.6	Chapter Conclusion . . . . .	32
<b>3</b>	<b>Integrated Evaluation of Small-Scale Farms</b>	<b>34</b>
3.1	Introduction . . . . .	35
3.2	Proposed Evaluation . . . . .	35
3.2.1	An Integrated Evaluation Method . . . . .	38
3.2.2	Structure of the Integrated Evaluation Model . . . . .	42
3.3	Strategic Planning Documents . . . . .	42
3.3.1	National Development Plan: Vision for 2030 . . . . .	43
3.3.2	National Framework for Sustainable Development . . . . .	43
3.3.3	Integrated Sustainable Rural Development Strategy . . . . .	45
3.3.4	Integrated Development Plan . . . . .	45
3.3.5	Catchment Management Strategies and Internal Strate- gic Perspectives . . . . .	48
3.3.6	Water Allocation Reform . . . . .	49
3.4	Integrating Objectives . . . . .	50
3.4.1	A Combined Evaluation . . . . .	50
3.4.2	Spatial Evaluation . . . . .	52
3.4.3	Environmental Objectives . . . . .	52
3.4.4	Social Objectives . . . . .	53
3.4.5	Economic Objectives . . . . .	53
3.5	Reducing Comprehensive Evaluation for Small-Scale Farms . . . . .	54
3.6	Indicators for Measuring Strategic Objectives . . . . .	55
3.6.1	Evaluating Complex Objectives . . . . .	56

3.6.2	Criteria for Reaching Social Objectives . . . . .	60
3.6.3	Criteria for Reaching Environmental Objectives . . . . .	63
3.6.4	Criteria for Reaching Economic Objectives . . . . .	65
3.6.5	Input and Output Information . . . . .	67
3.7	Applications of a Combined Framework . . . . .	71
3.8	Chapter Conclusion . . . . .	73
<b>4</b>	<b>Letaba Catchment Case Study</b>	<b>75</b>
4.1	Introduction to the Study Area . . . . .	76
4.1.1	Planned Development in the Letaba Catchment . . . . .	77
4.2	Evaluation of Small-Scale Farming . . . . .	78
4.2.1	General Information . . . . .	80
4.2.2	Crop Information . . . . .	83
4.2.3	Irrigation Information . . . . .	83
4.2.4	Social Information . . . . .	84
4.2.5	Rights and Safety at Work . . . . .	85
4.2.6	Market Information . . . . .	85
4.2.7	Farming Practices and General Operations . . . . .	85
4.2.8	Transport Information . . . . .	86
4.2.9	General Environmental Information . . . . .	86
4.3	Results of Evaluation Model . . . . .	86
4.3.1	Output 1 . . . . .	86
4.3.2	Output 2: Social Evaluation . . . . .	87
4.3.3	Output 2: Environmental Evaluation . . . . .	88
4.3.4	Output 2: Economic Evaluation . . . . .	89
4.3.5	Observed Trends in Results . . . . .	90
4.3.6	Validation . . . . .	90
4.4	Determining the Water Available for Development . . . . .	91
4.4.1	Methodology . . . . .	91
4.4.2	Results . . . . .	97
4.5	Hydrological Impacts of Results . . . . .	101
4.5.1	Irrigation in Great Letaba River Area or Molototsi River Area . . . . .	102
4.5.2	Irrigation from Surface Water or Groundwater . . . . .	103
4.5.3	Difference in Precipitation and Evapotranspiration . . . . .	103
4.5.4	Climate Change Expectations . . . . .	104
4.5.5	Development Recommendations from Hydrological Ob- servations . . . . .	106
4.6	Chapter Conclusion . . . . .	106
<b>5</b>	<b>Results and Discussion</b>	<b>109</b>
5.1	Summary and Conclusions . . . . .	109
5.1.1	Achievement of Research Objectives . . . . .	112
5.1.2	Answering of Research Questions . . . . .	112

5.1.3	Evaluation of Hypothesis . . . . .	113
5.2	Future Work . . . . .	113
5.3	Final Remarks . . . . .	114
<b>List of References</b>		<b>115</b>
<b>A User Interface</b>		<b>123</b>
A.1	Input . . . . .	123
A.2	Output 1 . . . . .	130
A.3	Output 2 . . . . .	134
<b>B SWAT Model for Letaba Catchment</b>		<b>136</b>
B.1	Watershed Delineation . . . . .	136
B.2	Land Use . . . . .	137
B.3	Soils . . . . .	137
B.4	Climate Data . . . . .	137
B.5	Evapotranspiration . . . . .	138
B.6	Irrigation . . . . .	139
B.7	Reservoirs . . . . .	139

# List of Figures

2.1	An Objective-Led Approach . . . . .	33
3.1	Traditional Evaluation Method . . . . .	39
3.2	Improved Evaluation Method . . . . .	40
3.3	Process of Constructing the Integrated Evaluation Model . . . . .	41
3.4	Interrelated Frameworks and Processes . . . . .	51
3.5	Employment and Growth Contribution of Agricultural Products. Adapted from: National Planning Commission (2012) . . . . .	55
3.6	The Virtuous Cycle: Interrelated National Objectives. Adapted from: National Planning Commission (2012) . . . . .	59
3.7	Step 4 of Constructing the Integrated Evaluation Model . . . . .	68
3.8	Evaluation Process . . . . .	74
4.1	Location of Letaba Catchment Area in South Africa . . . . .	76
4.2	Letaba Catchment Area . . . . .	77
4.3	Process for Evaluating Small-Scale Farms . . . . .	79
4.4	Zava Village Community Project. Source: Google Earth . . . . .	80
4.5	Mzilela Village Community Project. Source: Google Earth . . . . .	81
4.6	Duvadzi Farm. Source: Google Earth . . . . .	81
4.7	Dzumeri Farm. Source: Google Earth . . . . .	82
4.8	Quaternary Catchments in Letaba . . . . .	82
4.9	Municipalities Surrounding the Study Sites . . . . .	83
4.10	Study Sites and Growth Points in Greater Giyani Municipality . . . . .	84
4.11	Results for Output 1 (Strategic Documents Evaluation) . . . . .	87
4.12	Results for Output 2 (Sustainability Evaluation) . . . . .	88
4.13	Step 1: The Hydrological Model . . . . .	92
4.14	Step 2: Scenario Analysis . . . . .	93
4.15	Streamflow at Engelhard: Validation Period . . . . .	95
4.16	Average Annual Forecasted Streamflow at Engelhard . . . . .	96
4.17	Projected Domestic Water Requirements for the Letaba Catchment	100
4.18	Water Available Before Domestic and Environmental Reserves are Subtracted . . . . .	101
4.19	Evaluation of Results . . . . .	102
4.20	Streamflow Reduction from Irrigation (Great Letaba and Molototsi)	103

4.21	Great Letaba Monthly Streamflow: 2001-2010 and 2041-2050 . . . .	104
4.22	Molototsi Monthly Streamflow: 2001-2010 and 2041-2050 . . . . .	106
A.1	General Input Information . . . . .	123
A.2	Crop Information . . . . .	124
A.3	Irrigation Input Information . . . . .	124
A.4	Social Input Information . . . . .	125
A.5	Rights and Safety at Work Input Information . . . . .	126
A.6	Market Input Information . . . . .	127
A.7	Farming Practices and General Operations . . . . .	128
A.8	Transport Input Information . . . . .	128
A.9	General Environmental Input Information . . . . .	129
A.10	Output: NFSD . . . . .	130
A.11	Output: NDP 2030 . . . . .	130
A.12	Output: ISRDS . . . . .	131
A.13	Output: IDP . . . . .	131
A.14	Output: SDF . . . . .	132
A.15	Output: LED . . . . .	132
A.16	Output: CMS . . . . .	132
A.17	Output: WAR . . . . .	133
A.18	Output: Social . . . . .	134
A.19	Output: Environmental . . . . .	134
A.20	Output: Economic . . . . .	135
B.1	Watershed Delineation . . . . .	136

# List of Tables

1.1	Secondary and Tertiary Research Objectives . . . . .	8
1.2	Secondary Research Questions . . . . .	10
3.1	Focus Areas and Level of Relevant Frameworks . . . . .	36
3.2	Input Information for Evaluation . . . . .	69
4.1	Case Study: General Farm Information . . . . .	80
4.2	Crops Types and Yields: Jan-Dec 2011 . . . . .	84
4.3	SWAT Model Input Data . . . . .	94
4.4	Land Cover Distribution in SWAT Model . . . . .	94
4.5	Population Estimates by Area . . . . .	98
4.6	Summary of Water Availability and Projected Water Consumptions	99
4.7	Estimation of Irrigation Demand for Farm Locations . . . . .	105
B.1	SOTER and SWAT Soils . . . . .	138
B.2	Evapotranspiration Validation . . . . .	139
B.3	Consumptive Use of Dams. Adapted from: Aurecon (2010); Lepelle Northern Water (2011); Tshikolomo <i>et al.</i> (2012) . . . . .	140

# List of Acronyms

- ARC** Agricultural Research Council
- BEE** Black Economic Empowerment
- CMA** Catchment Management Agency
- CMS** Catchment Management Strategy
- CSIR** Council for Scientific and Industrial Research
- DEAT** Department of Environmental Affairs and Tourism
- DME** Department of Minerals and Energy
- DWA** Department of Water Affairs
- EAP** Environmental Assessment Practitioner
- EAU4Food** European Union and African Union cooperative research to increase Food production in irrigated farming systems in Africa
- EIA** Environmental Impact Assessment
- EMP** Environmental Management Plan
- EMPR** Environmental Management Programme
- EWR** Ecological Water Reserve
- FAO** Food and Agriculture Organization of the United Nations
- GDP** Gross Domestic Product
- GIS** Geographic Information System
- HDI** Historically Disadvantaged Individuals
- HRU** Hydrological Response Units
- IDP** Integrated Development Plan

- ISP** Interim Strategic Perspectives
- ISRDS** Integrated Sustainable Rural Development Strategy
- IWRM** Integrated Water Resources Management
- LED** Local Economic Development
- LUMS** Land Use Management System
- NDP 2030** National Development Plan 2030
- NEMA** National Environmental Management Act
- NFSD** National Framework for Sustainable Development
- NSE** Nash-Sutcliffe efficiency
- NSSD 1** National Strategy for Sustainable Development and Action Plan
- NWA** National Water Act
- NWRS** National Water Resource Strategy
- RDP** Reconstruction and Development Programme
- SDF** Spatial Development Framework
- SEA** Strategic Environmental Assessment
- SIA** Social Impact Assessment
- SIPS** Strategic Integrated Projects
- SWAT** Soil and Water Assessment Tool
- WAR** Water Allocation Reform
- WFGD** Water for Growth and Development
- WMA** Water Management Area
- WUL** Water Use Licence
- WULA** Water Use Licence Application



# Chapter 1

## Introduction

Various government bodies and departments on different levels of the South African government are involved in the country's development planning and environmental management. Sustainability and sustainable development are two recurring objectives in the planning of development and management of environmental affairs. All the involved regulatory authorities have a vision of sustainability, but they often lack in their implementation approaches to reach this objective. Therefore, even though sustainability is being pursued on a strategic level, in practice a complicated network of role-players, frameworks, guidelines, legislation and a lack of capacity often prevent successful implementation.

The purpose of this chapter is to introduce the problems experienced in the implementation of development planning and environmental management in South Africa. The inclusion of all activities in reaching strategic visions is discussed as well as problems with the "*regulatory approach*" in striving towards sustainability. A problem statement, research questions, objectives, delimitation and methodology of the thesis are provided. Finally, the structure of the rest of the document is explained.

### 1.1 Background

South Africa has a complicated system of authorities involved in environmental management and the strategic planning of development. The complicated set of responsibilities easily leads to a divide between strategic objectives and the implementation of these ideals. Apart from a national sustainable development framework, sustainable development is an ideal shared in the visions of most regulatory authorities. The different aspects of sustainable development, i.e. social impacts, economic impacts and environmental impacts are regulated and planned separately by different regulatory authorities, through various legislations, frameworks and strategic plans.

Since the 1980s the world started realising the necessity of sustainability and environmental reforms (Bell and Morse, 2008; Moldan *et al.*, 2012). With South Africa's new constitution in 1996, the National Water Act of 1998 (NWA) and the National Environmental Management Act of 1998 (NEMA), the country had the opportunity to bring new proactive laws and regulations into place. The new water law shifted from a system of riparian water rights<sup>1</sup> to one where a reserve is assigned for the natural environment and basic human needs. The remaining water is allocated with the aim of equity, sustainability and growth.

Development in South Africa aims to achieve economic growth, whilst bringing social upliftment and conserving the country's natural resources. Socio-economic growth is dependent on natural resources. In a water scarce country, water security and sufficient water quality (Nkondo *et al.*, 2012) can be a constraining factor for development. Therefore, water management should be included as an important part in any study about development and sustainability.

South Africa's water policies are some of the most progressive in the world (Perret, 2002; Colvin *et al.*, 2008), however progressive legislation does not necessarily have progressive implementation as a result (Rossouw and Wiseman, 2004; DWAF, 2008). Furthermore, progressive ideals might not even be realistic or executable. 15 years after the NWA there is still a problem with its implementation (Movik, 2013). Sustainable development in general is also an objective with implementation problems. Mainly because of uncertainties on how to implement it, measure it and determine what information is relevant (Walmsley, 2002).

One of the main causes of implementation problems is the complexity and interrelation of frameworks, legislations and guidelines from different parties. Many national departments are involved with environmental management in some way and have frameworks and legislation in this regard. The main priority of some strategies is the conservation of the environment (NEMA), others aim to ensure equity in the allocation of water resources (such as Water Allocation Reform (WAR)), while the NWA includes intentions of water use for economic growth. Other frameworks and programmes exist with the intention of economic and social growth through the use of natural resources.

Just as sustainable development is an integrated concept of balancing social, economic and environmental needs, an integrated group of involved parties are

---

<sup>1</sup>Riparian Water Rights follow the principle that owners of land are given the right to the water adjacent to their property.

responsible for the different functions of sustainable development. Although the ultimate goal is similar, the different focuses of the different parties actually do not result in an integrated approach to sustainable development, but rather to a complicated system with many strategic ideas and difficulties with implementation.

Development guidelines and strategies are provided on different levels of government. Swilling (2008) commented on the contradicting development guidance for Local Government. The Integrated Development Plan (IDP) of a municipality pursues development while an Environmental Impact Assessment (EIA) and the National Environmental Management Act (NEMA) measure and control the environmental impacts of developments. Although sustainable development is mentioned as an ideal in all of these documents and assessments, there is no clear definition or strategy of implementing sustainable development with measures such as re-use of resources and renewable energy. Swilling (2008) refers to this approach of the Local Government as a dualistic “*development-plus-impact-assessment*” paradigm. Consequently, not only is implementing sustainable development unclear, it is also ineffective.

Environmental evaluation tools that are available cannot be used properly because of confusion and conflicts between environmental, economic and social concerns (Rossouw and Wiseman, 2004). Evaluation against strategic plans is also difficult because of the many levels and sectors involved. The NEMA, although environmentally centered addresses economic and social concerns as well, implementing the integration of these objectives are however very difficult. Integrating these concerns would require effective and close institutional cooperation (Rossouw and Wiseman, 2004). Since regulatory systems for environmental impacts are in place, this is then often the limit of contribution to sustainability individual activities would go to.

One of the problems associated with environmental management, development planning and sustainable development is the collection of parties and documents involved. This causes challenges with the implementation of environmental management and development planning objectives and also makes it difficult to translate these objectives to individual activities. A number of problems related to the implementation of environmental management and development planning objectives are discussed below.

### **1.1.1 Divided System of Planning, Implementation and Strategy**

There is a complicated collection of frameworks and documents involved in managing development in terms of environmental regulation, spatial planning,

regional development planning, water policies as well as national plans regarding development and sustainability. These functions occur across different levels of government and focus on specific issues.

This complex network leads to the duplication or negligence of tasks as well as confusion. There are some attempts to integrate the frameworks and policies of the various sectors, but in general there is more of a reliance on co-operation and also on systems of voluntary action, which in turn complicates implementation (Geach and Peart, 1998).

Another problem with the many parties and documents involved is that their objectives and visions are not always aligned. For example, some groups would focus on economic growth, whilst others have environmental concerns as their priority. Policies involving economic and social growth would often have contradictory spatial consequences (National Planning Commission, 2012).

### 1.1.2 Activity Level Impacts

Development takes place with the agglomeration of new activities in an area. These new activities use a combination of resources from the area (e.g. knowledge, labour, natural resources, land) and have an impact on its social, economic and environmental conditions. Although there are numerous frameworks describing development goals from different viewpoints (i.e. from social, environmental or economical perspectives) it is difficult to assess an individual activity in terms of these development goals. Since the combined effect of new activities contributes to the development of an area, it would be important to undertake such evaluations and relate an individual activity's impact on a region to the overall vision of the region.

The concept of achieving a vision through the contributions of all parties involved is illustrated with the following words from the National Development Plan: Vision 2030 (National Planning Commission, 2012):

*“I am not self-sufficient alone. We are self-sufficient in community.”*

These words describe the contribution of all individuals (and individual activities) to the success and sustainability of an area, as well as the dependence between them. All activities are not always included in sustainability development strategies. Usually strategies would involve certain projects to help with sustainable development (e.g. projects by local government or partnerships). Although these projects have great value, it would be ideal if all activities in an area could make a contribution to its sustainability.

Evaluating individual activities against regional planning objectives and regulations is valuable, because of the cumulative impact of individual activities on the sustainability of a region. However, such an evaluation would also be a useful measure to compare activities against each other in the case where a decision between two activities is required.

### 1.1.3 Involve Strategic Planning Objectives in Decision-Making

All policies and mechanisms for guiding development do not always support sustainability objectives. For example, EIA and re-zoning usually do not consider strategic planning objectives or the cumulative effect of allowing an activity (Todes *et al.*, 2009). Accordingly, even though sustainability is part of the strategic plan, it does not necessarily reach the execution phase. Integrating all strategic plans in implementation processes is necessary.

Other regional specific or situation specific factors can influence potential for sustainable development. An example of such a determining factor is water and will be used as an example in this study. Water, being essential for development and environmental objectives, is often the common factor between various departments and the determining factor for economic growth, social development as well as sustainability. Water use authorisation is consequently also one of the processes experiencing the most problems and should therefore play an integral part in development evaluation, especially in water scarce areas.

The processes of water use authorisation and allocation are not currently integrated in strategic planning. As a consequence, the visions as proposed by strategic planners are not always realistic in terms of the resource capacities. For example, in the Letaba catchment large agricultural growth is planned through the IDP, but the CMS states that there might not be enough water to support agricultural expansion. Consequently, not only should strategic planning objectives be taken into consideration with activity level decision-making, the strategic objectives' executability should first be validated.

### 1.1.4 An Alternative to the Regulatory Approach

Sustainability and environmental management are usually enforced through regulatory approaches. This approach has received criticism, since mitigating negative effects is not enough to ensure sustainability (Rydin, 1998; Cashmore, 2004; Swilling, 2008; Todes *et al.*, 2009). An “*objective-led*” approach, as suggested by Pope *et al.* (2004), is an alternative to the regulatory approach, where all projects, plans and activities are measured according to their align-

ment with a specific vision, rather than focusing on the mitigation of harm.

As mentioned in the previous section, strategic objectives are not included in implementation of environmental management. Evaluating alignment with common objectives and strategies is one way to translate strategic visions to the implementation level.

### 1.1.5 Potential Impact of Small-Scale Farming

Strategic planning documents such as the ISRDS and LED plans realise the potential of small-scale farming in bringing social and economic growth to poor rural areas. Small-scale farming has shown great potential internationally in reducing poverty in rural areas. Jobs are created, increased incomes generated and furthermore, productivity of small-scale farms can be comparable and even higher than that of large commercial farms (Kirsten and Van Zyl, 1998). Small-scale farming can also play an important role in ensuring food security.

Small-scale farming is seen as one of the biggest opportunities in alleviating poverty in rural areas. Since more than 17 million South Africans live in rural areas, small-scale farming should receive the necessary attention (Perret, 2001). However, the great dependency on government and other external help is also one of the main constraints of small-scale farming (Machethe, 2004). Without proper support small farms might use farming practices that harm the environment and use water inefficiently.

## 1.2 Problem Statement

South Africa's growing economy and fast population growth are placing increased stress on the country's natural resources. Conversely, the sustainability of economic growth and development in Africa will depend on the situation of the continent's water resources (AMCOW, 2012). Resources<sup>2</sup> should be used in a way that maximises the economic and social outputs. Strategic planning frameworks lay out guidelines and regulatory systems are in place to pursue these goals.

Implementation of sustainable development objectives faces many problems in South Africa as seen in Section 1.1.1. The current complex collection of frameworks on development and environmental matters often has different objectives

---

<sup>2</sup>Since water is often the constraining resource, resource and resource allocation would in many cases refer to water and water use authorisation. However, here it also refers to other resources such as land, energy, labour and knowledge. Therefore, through the allocation of resources an activity is made possible.

and visions. In other instances strategies, goals or functions are repeated which makes the exact purpose of each framework unclear. Furthermore, proper and clear objectives are set, but there is usually great uncertainty involved with ways to actually implement the objectives. Section 1.1.2 further discusses how strategic plans, although very good in principle, are difficult to translate to the level of individual activities. This makes it difficult to evaluate whether the activity is aligned with a region's vision. A method is required to evaluate individual activities against the objectives of regulatory authorities involved in strategic development planning.

Other problems regarding implementation of sustainable development and environmental planning are the unrealistic visions set and the implementation approach used. Implementation is approached through projects and does not involve all activities in an area. In Section 1.1.4 problems with the regulatory approach for implementation are discussed. Possible alternatives are to follow sustainability principles or to aim towards objectives.

### 1.3 Research Objectives

#### **Primary Objective:**

To develop a simplified method of evaluating an individual activity in the context of regional planning and sustainable development goals.

Apart from the primary objective, other related problems were identified which this study also aims to address. Table 1.1 summarises these additional objectives, while they are discussed in more detail below.

#### **To integrate the goals of different parties involved in regional planning**

One of the first objectives of this study is to study the relevant legislation, documents, policies and frameworks related to development and sustainability planning in South Africa. The aim is to identify the synergies, conflicts and the most important features.

The purpose of this analysis is to determine how the most important functions, criteria and objectives of all the frameworks can be combined into one structure. Thereby, creating a condensed evaluation method with objectives of different departments regarding sustainability, ecological integrity, economic growth, social equity and development combined. This combined method eliminates all duplication of work and highlights conflicts between documents.

**Table 1.1:** Secondary and Tertiary Research Objectives

Secondary Objectives	Tertiary Objectives
Integrate the goals of different parties involved in regional planning	Compare development frameworks against each other to identify conflicts and agreements
	Assess all environmental, social and economic concerns in one method
	Make evaluation against many frameworks simple
Use one uniform, consistent method of evaluation by different departments and for different processes	Save correspondence time between involved parties
	Help understanding and collaboration between different parties
Pursue alignment of everyone to a common vision	Identify the objectives and visions of all parties involved in strategic planning
	Promote sustainable development principles
	Consider cumulative effect of allowing a certain development type
Pursue the implementation of development and sustainability objectives	Create awareness of strategic goals for everyone to consciously strived towards
	Make strategic goals applicable to all individual activities



To evaluate a single activity against all related frameworks and legislation is a very complicated and time-consuming task. It would be much simpler to evaluate against one framework.

**Use one uniform, consistent method of evaluation by different departments and for different processes**

There is currently no quick way to see how an activity contributes to the vision as defined by all role players in an area. A condensed method of evaluation that contains critical information from all relevant parties, frameworks and regulations can be used by all role players involved. This can save correspondence time between parties since they can easily assess compliance with other parties' ideals. Communication and collaboration could be improved if a uniform method is used by all as a reference.

**Pursue alignment of everyone to a common vision**

Through ensuring everyone is aligned to a common vision, strategic objectives are pursued by everyone. However, different parties involved in strategic planning have different visions. All these visions need to be identified and combined in common objectives. The combined objectives would include sustainable development principles.

Goals as envisioned by strategic planners might be unrealistic. The cumulative effect of encouraging activities as proposed by the identified objectives need to be assessed to determine whether it would be realistic and sustainable.

**Pursue the implementation of development and sustainability objectives**

By combining strategic goals with regulations and guidelines, the vision of an area would constantly be addressed and pursued.

Although individual activities collectively determine sustainability and contribute to the growth of a region, it is difficult to relate their impact to a regional scale. The combined approach would make it easier to implement environmental and development policies from an individual activity level.

## 1.4 Research Questions

The primary research question of this study is to determine how the complicated collection of frameworks, strategic documents and policies can be made more accessible for quick evaluation as well as relevant to individual activities. However, to answer this question there are multiple secondary and tertiary questions to be answered first. These questions are summarised in Table 1.2.

**Table 1.2:** Secondary Research Questions

<b>Secondary research questions</b>	<b>Approach</b>	<b>Document Structure</b>
Which frameworks, plans, policies and parties are involved in strategic development and sustainability planning in South Africa?	Literature review	Chapter 2
How are all these strategic documents interrelated?	Analysis of frameworks, policies and documents	Chapter 2
How are strategic goals implemented?	Literature review	Chapter 2
How can individual efforts (such as a small-scale farm) have an impact on reaching strategic objectives?	Literature review	Chapter 2
How can individual activities be evaluated against broad strategic visions and objectives?	Model Development: Literature review and analysis of frameworks, policies and documents	Chapter 3
How can the objectives of the plans be structured to make it less effort to evaluate simultaneously?	Model Development: Analysis of frameworks, policies and documents	Chapter 3
How can these strategic documents be made applicable to small-scale farming?	Model Development: Analysis of frameworks, policies and documents	Chapter 3
Can the developed method be applied to real farms and does it provide expected results and useful information?	Case study	Chapter 4
How does area/industry specific constraints compare with results from alignment with strategic objectives?	Hydrological modelling	Chapter 4

The method used to answer the questions is provided as well as where it is addressed in the document.

## 1.5 Hypothesis

All activities in an area contribute to some extent to the development and sustainability of the region. Keeping this information in mind, the following hypothesis is considered:

*“A method combining all relevant strategic documents, frameworks and policies can be applied to evaluate an individual activity’s alignment with regional planning and sustainable development objectives.”*

## 1.6 Delimitation

Not all frameworks related to the mentioned topics will be included in the study. Frameworks were chosen to represent development planning on different levels of government and from different aspects of sustainability. A total of eight frameworks were identified. For further studies more frameworks can be regarded.

This study is applied to a rural region and although the methodology can be used to make it applicable to any regions, some specific information such as information regarding coastal areas, are not included or related to specific sectors. Regional documents such as the Integrated Development Plan (IDP) and Interim Strategic Perspectives (ISP) are chosen according to the specific study area. For other regions, the region’s relevant documents and frameworks should be studied and included.

The study examines how a certain type of activity can be evaluated against applicable strategic plans and frameworks. However, it is only applied to the case of small-scale farms.

## 1.7 Methodology

In order to evaluate the performance of projects, activities or a specific sector with regards to the strategic objectives of different spheres and sectors, the appropriate objectives need to be identified and analysed. The evaluation in this study will include two important functions, namely the evaluation of alignment with the vision of regulatory authorities and also of contribution to sustainability objectives. Sustainability objectives are included since sustainability is a shared ideal of most regulatory authorities.

This evaluation commences through textual content analysis of secondary data. A methodological study is performed to develop a model to evaluate small-scale farms against the analysed secondary data. A case study follows to validate the developed method incorporating numeric and textual primary data (Mouton, 2011).

Small-scale farming is chosen as an example of a type of individual activity to be evaluated. The applicable strategies will be investigated and evaluated

to determine how it is relevant to small-scale farms and in what way small-scale farms can influence strategic objectives. This information will then be organised and structured in such a way to easily measure small-scale farms and provide helpful results in terms of the farms alignment and contribution to strategic visions and objectives.

The developed method will be applied to four farms in a study area in the Limpopo Province to investigate whether it is applicable and implementable to different types of small-scale farms and whether it yields the expected results. Here is dealt with primary data of both textual and numeric nature.

The study area chosen as a case study has water constraints which might affect the expansion of small-scale farming. Therefore, hydrological modelling of the study area will be performed to determine the impact and feasibility (in terms of water availability) of small-scale farming development. The aim of this exercise is to evaluate an activity's performance against strategic objectives in comparison to its environmental impact. This will also serve as an assessment of the validity of strategies with respect to the identified constraints. Although the majority of the work is done through qualitative studies, this part of the thesis is done through quantitative methods.

## 1.8 Document Structure

### Chapter 2: Literature Review

A thorough review of literature is necessary to gain an understanding of the problems with current environmental legislation and development planning. The goals of the various role players need to be analysed to see how it overlap and differ and how it is being implemented or not implemented. The concept of sustainable development in South Africa is reviewed to determine to what extent it is pursued and opposed.

Strategic planning is often not taken into account with development decision making as it is not directly applicable to individual activities. However, it is the agglomeration of these individual activities that determines whether sustainable development is truly pursued. Ways to implement these strategic visions at activity level are explored.

Problems with implementation of environmental legislation are investigated. The development approval, water use authorisation, EIAs and other related processed such as re-zoning of land need review to identify the reasons for inefficiency in order to improve the process. Room for applying goals of all parties in resource allocation also need to be identified.

Small-scale farming has great potential in rural areas in South Africa for socio-economic growth. This sector is also supported by the government. Determining whether it contributes to strategic objectives of the country as well as to rural regions would be both interesting and helpful.

### **Chapter 3: Integrated Evaluation Model**

Chapter 3 will propose a method to deal with issues experienced in environmental management and planning for development. A single evaluation method (the Integrated Evaluation Model) is discussed which includes critical aspects of all relevant policies and objectives related to development planning and sustainability concerns as identified in Chapter 2. Hereby a quick method is created that can be used to evaluate an activity against the most important strategies and policies applicable to that region.

By using the Integrated Evaluation Model, all parties' concerns are considered in decision-making and duplication is minimised. Disparities and compliance with specific frameworks or sustainability concerns are identified simultaneously and enables further evaluation to focus on the appropriate factors.

Individual activities can be evaluated by this model to determine whether it aligns with regional planning and objectives. The result of the evaluation can be used for development decision-making and with processes such as Water Use Licence Application (WULA) and Land Use Management System (LUMS). Different interconnected departments can evaluate their objectives against other parties' goals.

The method will specifically be developed for application for small-scale farms.

### **Chapter 4: Evaluating Potential Developments**

In this chapter the recommendations for improving the environmental management and regional planning will be validated by applying it to a case study. Four small-scale farms in the Letaba catchment in the Limpopo Province will be evaluated by the developed method to determine whether the method is effective.

### **Chapter 5: Results and Discussion**

The final chapter provides the results of the study and conclusions drawn from the work. Plans for further research and advice for application in other areas are also provided here.

## 1.9 Chapter Conclusion

Problems with the implementation of strategic visions on an activity level as well as the complicated network of parties and documents involved in development planning and environmental management provided a research objective for this thesis. The problems will be investigated thoroughly in the next chapter and a proposed solution will be developed in Chapter 3. As validation, the proposed solution will be implemented as a case study in Chapter 4.

## Chapter 2

# Literature Review

This chapter aims to provide the necessary information required to understand the problems and objectives of the thesis. A literature review was conducted to understand the complicated network of involved authorities in development planning and implementation in South Africa. A background to these authorities and their interrelated functions are provided as well as problems experienced with the implementation of their objectives.

The current approach to pursue sustainable development is provided, mentioning the issue with ineffective approaches to strive towards this goal as well as general problems with implementation of environmental management. The concept of the contradictory ideals of development and conservation is discussed, followed by the important role of water in development. The value of implementing strategic visions at an activity level is also investigated. Finally, small-scale farming in South Africa is introduced with mentions to its opportunities and constraints.

### **Objectives:**

Investigate relevant information on strategic visions and sustainability and their implementation.

### **Research Questions to be answered:**

1. Why is strategic development planning and environmental management in South Africa complicated?
2. What are the problems with implementation?
3. How can individual efforts (such as a small-scale farm) have an impact on reaching strategic objectives?

## 2.1 The System of Strategic Development Planning Documents

Todes *et al.* (2009) refers to two tools applicable to development planning and environmental management, namely the regulatory system surrounding development and the strategic plans developed at different levels of government. Existing and proposed activities in a region should consequently be assessed in terms of both these sets of tools in order to establish whether it contributes to the vision of the area.

Development requiring environmental authorisation often needs to obtain permission from various departments: e.g. a water use licence (National Water Act 36 of 1998), environmental authorisation (National Environmental Management Act 107 of 1998) and a waste management licence (Waste Act 59 of 2008). There have been suggestions to combine these authorisations into one, but such a procedure is currently not possible.

The problem is not just the need for integration, but more the complexity of the functions of all the role-players. Even within the DWA there are many units with shared responsibilities which end up with the duplication of responsibilities or responsibilities being forgotten (King and Pienaar, 2011).

Apart from requiring permission, the right type of activities should be encouraged that contribute to the objectives of all involved parties (i.e. development ideals as well as environmental and social needs). An evaluation of all legislation and frameworks from the regulatory and strategic planning systems would be required to make the right development decisions.

The strategic documents and frameworks related to planning, environmental management and sustainable development included in this study are:

- National Framework for Sustainable Development (NFSD)
- National Development Plan: Vision 2030
- Integrated Development Plan (IDP)
- Catchment Management Strategy (CMS)
- Water Allocation Reform (WAR)
- Integrated Sustainable Rural Development Strategy (ISRDS)
- Local Economic Development (LED)
- Spatial Development Framework (SDF)



These frameworks and strategic plans were chosen to represent different levels of government and varying areas of focus with regards to sustainability.

### 2.1.1 Background to Development and Environmental Functions

There have been cases of countries using an integrated approach to legal and institutional planning and environmental management. However, whether this approach would succeed in reaching economic, social and environmental goals is uncertain (Todes *et al.*, 2009). In South Africa, the system related to environmental management and planning is highly divided and complicated, causing duplication and confusion. Although an integrated system is not necessarily the solution, there is a need for making the system more accessible and comprehensible.

The National Development Plan 2030 (NDP 2030) as well as the National Framework for Sustainable Development (NFSD) provides insight into the way the country plans to develop and the problems it aims to address with development. Since development is influenced by many other policies and plans other considerations such as water legislation, land use and environmental policies and certain social concerns need to be considered as well. On a regional level, the SDF and IDP further elaborate on regional development plans. Both spatial planning and a local economic development plan have been identified as important starting points for sustainability implementation (Abrahams, 2003; Todes *et al.*, 2009).

Since all these frameworks are concerned with the development of a specific area, new activities should be aligned with all regional plans. These plans make reference to each other, but it is difficult to determine if it is complied to. For example when performing an EIA compliance with the Provincial Spatial Development Framework, National Development Plan, Integrated Development Plan and regional Spatial Development Frameworks need to be confirmed. One combined method to evaluate against all relevant strategic documents would make this process easier and consistent.

### 2.1.2 Environmental Legislation versus Development Visions

There has always been a conflict of interest with the pursuit of sustainable development. Since economic growth and social development are important objectives, it often happens that the environment is damaged. Sustainable development is pursued, but often enforced through the wrong methods. In South Africa the approach often entails merely assessing impacts of activities

rather than actually changing the way the activity is approached (Swilling, 2008). In reality environmental legislation is applied to conventional development methods, rather than balancing social, economic and environmental requirements.

The “*EIA approach*” of development plus the assessment of its impacts is a dualistic system. Some countries such as Australia and the U.K. are starting to move away from the EIA approach to approaches that incorporate sustainability principles in planning (Todes *et al.*, 2009).

Following the dualistic system, development and environmental impacts are seen as opposing objectives, where a compromise needs to be found between the two. EIAs and related processes are seen as an inconvenience to development and as delaying the development process (Swilling, 2008). Sustainability should be approached as a positive concept rather than as a restricting one.

The first step organisations go through with regards to environmental actions is compliance. This is known as the first era of environmental consideration. In the second era the necessity to go beyond mere compliance was realised. These actions were followed by the third and fourth eras represented by eco-efficiency and eventually sustainable development (Nattrass and Altomare, 1999):

- 1st Era (1970s): Compliance
- 2nd Era (1980s): Beyond Compliance
- 3rd Era (1990s): Eco-efficiency
- 4th Era (2000s): Sustainable Development

Municipal implementation of broader environmental strategies is still mainly in the first era of environmental consideration, e.g. issuing of WULs.

The NWA (DWAF, 1998) states that the National Government has the responsibility to ensure equitable allocation of water and the use of water for the benefit of the public. However, the current allocation system being more compliance orientated follows an approach of not harming the public rather than being beneficial to the public. Most environmental management approaches deal with the reduction and/or restrictions of negative impacts.

Although South Africa has very good sustainable development frameworks, the first step of “*compliance*” is still mostly used in dealings with environmental and water management. Related to this Movik (2013) also suggests an approach based on benefits associated by using a resource, rather than focusing on restricting the harmful impacts.

Resources used to start a new activity are amongst others nature, land, labour and knowledge (Knickel and Renting, 2000). These resources should be used in the best way to pursue regional growth and sustainable development. The Constitution (Section 24 (b) (ii)) also includes the right to a protected environment as well as sustainable development. It further mentions that resources should be used in a way that is economically and socially justifiable. If enforced, this would mean that an activity should not only have an acceptable impact on the environment as determined by an EIA, but should justify its use of resources through its social and economic contribution.

Other studies have investigated problems and insufficiencies with the regulatory approach to environmental management and achieving sustainable development. For example, rather than implementing regulations, Rydin (1998) suggests a focus on innovation and change in behaviour regarding environmental impacts.

### **2.1.3 Disagreements, Duplication and Disregarding of Tasks**

The following departments have been identified by NEMA as having potential effects on the environment or are involved in the management thereof:

- Department of Environmental Affairs and Tourism
- Department of Land Affairs
- Department of Agriculture
- Department of Housing
- Department of Trade and Industry
- Department of Water Affairs
- Department of Transport
- Department of Defence
- Department of Minerals and Energy
- Department of Health
- Department of Labour

All of these departments are somehow involved with legislations and implementation or in controlling their impacts on the environment. In having so many parties involved, confusion, duplication and/or neglecting of tasks will

arise. The effects of various social and economic policies can sometimes have contradicting spatial effects and need to be aligned (National Planning Commission, 2012, p. 276).

As previously mentioned, the South African policies regarding sustainability and environmental affairs are sufficient, but there is a problem with the way the various policies are approached especially concerning the implementation by local, provincial and national institutions not being sufficiently integrated (Hamann and O’Riordan, 1999). Kotze (2006) described the institutional fragmentation regarding environmental governance as both on a vertical and horizontal level. Vertically there is fragmentation between the national, provincial and local departments. Horizontally, there are many government departments involved in environmental governance. These include: Department of Environmental Affairs and Tourism (DEAT), Department of Water Affairs (DWA), Department of Minerals and Energy (DME), Department of Agriculture and the South African Heritage Resource Agency.

In terms of legislation there is even more fragmentation. Usually there are for any type of environmental topic (e.g. biodiversity, water supply, development) national level legislation as well as further provincial legislation and acts. On a local level there will be the Integrated Development Plan (IDP), spatial development frameworks and zoning policies (Kotze, 2006).

A study by Todes *et al.* (2009) proved that the divided system of planning and environmental management results in tasks being duplicated and inefficiency. They found that although not all proposed activities have to go through both EIA and planning processes, when it is indeed necessary the average processing time increases from three to six months to as long as 15 months.

An example of duplicate processes is the re-zoning process and performing an EIA. Both processes would involve undertaking similar economic and social assessments, traffic analysis and visual impact studies. It was also noted that the quality of these processes is not always adequate. It is seldom that broad strategic planning objectives are considered in these studies or cumulative impacts assessed (Todes *et al.*, 2009).

Pollution is controlled by NEMA, NWA, Environment Conservation Act, the Health Act and many other acts. The same counts for many other issues. With natural resource planning and land use there are management responsibilities on both national and provincial level, each bounded to and performing management according to their specific acts. This leads to a system which is neither integrated nor sustainable (Kotze, 2006).

However, concerning legislation concerning water use, NEMA clarifies that although many authorities are involved with water related legislation, authorisation for the use of water cannot be given by any authority without the approval of DWA.

Other countries such as Australia and the U.S.A. have centralised bodies in control of environmental affairs that can coordinate the roles of the various departments (Kotze, 2006). South Africa's DEAT does not serve that function, but only offers guidelines.

### 2.1.4 The Role of Water in Development and Environmental Management

All human activity and development are directly or indirectly dependent on water. Water is also one of the most important components of all environmental matters. For this reason many parties are involved with water related management. Just as the availability and quality of water have a big impact on human wellbeing. Humans have an impact on environmental health and a responsibility to use and manage it sustainably.

It is very important that development and economic planning is integrated with water planning. Ensuring that these plans are aligned with water availability is the responsibility of CMAs and DWA (DWAF, 2008).

Water management in South Africa underwent a transformation in 1998 with the new National Water Act (NWA). The NWA acknowledges the National Government's responsibility of the country's water and their role to ensure that it is used sustainably, allocated equitably and to the benefit of the whole nation (DWAF, 1998). Also, the National Water Resource Strategy (NWRS) aims to ensure that water is not an obstacle for development in the country.

The National Water Policy Review addresses problems with the NWA. One of the major concerns is allocations. 98% of water in the country is already allocated (Department of Water Affairs, 2013), the policy needs review in order to make this water allocatable again.

Furthermore, water should be allocated equitably to all who need it and in a way which makes sense to the country's development. Currently, 62% of water is allocated to agriculture, while this sector only contributes 4% to GDP (Parker, 2013). Nieuwoudt *et al.* (2004) investigated the contribution of various sectors per unit of water used. Agriculture provides the lowest GDP as well as employment per unit water used. This would indicate that less water should be allocated to agriculture. In 2004 one cubic meter of water used

for agriculture added R1.50, in contrast to industry where one cubic meter equated to R157.40. Considering employment, one million cubic meter can be translated to 250 jobs in agriculture and 1 785 000 jobs in the glass industry. However, when looking at these figures in other ways such as jobs per value added, agriculture is the leading sector in job creation and shows that merely regarding direct benefits associated with the use of unit water is not adequate.

## 2.2 Sustainable Development in South Africa

Sustainable development involves balancing environmental, social and economic interests when making decisions for development. Sustainability is included in this study as it is an important theme in most strategic documents reviewed. Since, each document focuses on and promotes the health of a different sustainability sphere, an evaluation against sustainability combines the documents in some sense and balances any biases.

The most well-known definition for sustainability dates to the 1987 report *Our Common Future* in which was stated sustainable development is “*economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*” (WCED, 1987). This report, also known as the *Brundlandt Report* was one of the first descriptions of the concern surrounding economic growth on the environment. Since then, sustainability and sustainable development have been part of most long term strategies of organisations to different levels of governments and companies of all types. Being such a widely used and multi-disciplinary concept, there are many opinions and definitions of sustainability. Finally, a few years after the *Brundlandt Report*, Campbell stated that “*sustainability is in the eye of the beholder*” explaining the situation surrounding this vague, but popular concept (Ridaura, 2005).

Sustainability is the key in using resources from nature for economic and social growth whilst not harming it unfairly. Sustainability also places equal focus on social, economic and environmental needs. Pursuing sustainability, would therefore align (with compromises) with the strategies of most parties involved with environmental and water management. Where some focus on social equity and others on environmental health, the definition of sustainability covers all these goals.

Although South Africa does have a framework for sustainability, the guidelines provided by this framework are not being implemented by other parties.

The evaluation of sustainability is very important for planning the way forward, for controlling and weighing alternatives. Many indicators have been

developed to explain certain aspects of sustainability. Aldo Leopold said in 1949, “*a thing is right if it trends to preserve the integrity, stability, and beauty of the biotic community. It is wrong if it trends otherwise*”.

Sustainability is a multidisciplinary and highly integrated and complicated term. Ravetz (2000) believes nothing can truly be called sustainable in our fast changing world with many uncertainties. However, in contrast, he also believes in the vital importance of sustainability assessment.

Important concepts of sustainability are the value of nature and intergenerational equity. Nature’s resources are valuable for the economic prosperity of humans, but are also valuable for the sake of nature itself, as defended by environmental activists. The second concept derives from the moral appeal of a duty towards future generations (Becker, 1998). The first concept is usually used by economists. The Green Growth Knowledge Platform is an international group of organisations and researchers pursuing economic growth in a sustainable way. They aim to make theoretical green growth knowledge accessible to apply in practice.

The most important and widely implemented frameworks regarding environmental protection and sustainability are Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and Environmental Management Plan (EMP). Environmental assessment and management frameworks have been implemented in developed countries much more and with much greater success than in developing countries (Retief, 2007). However, these assessments and management strategies are especially important in developing countries as these countries often depend on primary economic activities (e.g. mining, agriculture, tourism) and communities in these countries relying on subsistence farming are vulnerable to a damaged environment.

An EIA is the process to assess, but also identify, predict and mitigate a proposed project’s impacts on the environment before it is approved. Impacts on the environment are primarily focused on effects on the biophysical environment, but social effects are also considered. EIA is implemented worldwide and is compulsory in most developed countries and many others, including the European Union, Australia, Canada, Philippines, Columbia and South Africa (Rorarius, 2007). The 1989 Environmental Conservation Act made Environmental Impact Assessment (EIA) mandatory for certain activities<sup>1</sup> in South Africa (King and Pienaar, 2011).

---

<sup>1</sup>Activities requiring EIAs are listed in Government Notice No. R. 386 and R. 387 in Government Gazette No. 28753 of 21 April 2006. These activities include various construction projects, electricity generation, treatment and storage of waste, lawns and playing fields, filling stations and a range of other activities which can potentially harm the environment.

Since EIA is mostly focused on impacts on the natural world a Social Impact Assessment (SIA) was developed to evaluate social impacts of projects. A specific guideline for implementing SIA has not yet been developed, but generally SIAs would include the collaboration with stakeholders through community involvement. For large projects, this method can be very difficult to implement and control (Rorarius, 2007). Thus far, EIA and SIA are still independent processes.

As experience in the field of environmental management increases, many organisations and governments begin to realise that EIA alone is not enough to protect the environment. They suggest moving in the direction of management plans. EMPs are discussed in the next section and usually now form part of an EIA (Kruger, 2005). EIA is acknowledged to be successful in mitigating negative impacts, but cannot directly (or without other measures) contribute to sustainable development (Cashmore, 2004).

Although the definitions and objectives of EMPs can vary, some of the main objectives are to ensure that the applicable environmental regulations are complied with, to be able to react to changes and other unforeseen events and to continuously provide feedback on environmental performance for improvement (Lochner, 2005). An EMP usually follows from an EIA.

NEMA established a Committee for Environmental Co-ordination of which one of their main functions is to promote the purpose and goals of EMPs. The committee is comprised of members from many government departments including: The Department of Environmental Affairs and Tourism; the Department of Water Affairs; the Department of Minerals and Energy; the Department Land Affairs and the Department Constitutional Development (Republic of South Africa, 1998).

Projects, activities and organisations of different sizes can all have an EMP. EMPs do not have a specific format and can vary significantly regarding the level of detail. This is because certain projects are more complex or in more sensitive areas (Lochner, 2005). However, it also makes it difficult to compare. A single system to compare all projects, activities and organisations on the same conditions will be useful.

According to Retief (2007) there is not much understanding and control on how SEA is implemented in South Africa. Internationally SEA is usually implemented according to certain legislations and specific guidelines. However, in South Africa SEA is still a voluntary act. Despite the lack of legislative requirements of SEA, it has been implemented widely through voluntary action as the need for this type of assessment is acknowledged. In South Africa SEA is mostly performed by the private sector and there is a lack of capacity in the



public sector to perform this type of assessment.

Since SEA has a wide range of applications, it has become a very varied concept with diverse methodologies and scales. It has been called an umbrella concept to illustrate the many applications which could possibly form part of SEA (Retief, 2007).

The South African guidance on SEA focuses on the opportunities and obstacles the environment has for human activities, whereas usually in other countries the focus would be on the impact of human activities on the environment.

Retief (2007) undertook a study to evaluate the effectiveness of SEA specifically in South Africa and the results were negative. One of the main reasons it was described as ineffective was the inability of the SEA applications to affect the plans, programmes and related decision-making. The reason for this might be the need for legislation regarding SEA.

Apart from these practical assessments and tools, there is also the National Framework for Sustainable Development (NFSD) from the Department of Environmental Affairs and Tourism (DEAT). This document provides guidelines to pursue sustainable development. Apart from policies including sustainable development, stakeholders at different levels are trying to include sustainability principles in their activities (Ridaura, 2005).

## 2.3 Implementing Vision at an Activity Level

This section introduces the idea of all parties in an area contributing to the regional welfare and success. This could be done by aligning all activities to a common objective.

### 2.3.1 Aligning Activities with Regional Planning

As mentioned in Section 2.2, merely avoiding negative impacts is not enough to ensure sustainability and regional prosperity. Pope *et al.* (2004) refers to “*objective-led*” integrated assessment as an alternative to assessing negative impacts (such as EIA). This integrated assessment measures the extent to which a proposal, plan, programme or activity aligns with a specific vision with certain environmental, social and economic objectives. They regard this as a proactive approach with a target in sight. To achieve the desired outcomes of sustainable development, sustainability systems and approaches should be applied at the earliest stage (Hunt *et al.*, 2008).

Keeping the “*objective-led*” approach in mind it makes sense to attach value to strategic planning objectives such as a municipal Integrated Development Plan (IDP), the National Framework for Sustainable Development (NFSD) and the National Development Plan 2030 (NDP 2030) and to measure activities against these visions. Rather than mitigating negative effects through regulations, all activities can be aligned to achieve a certain vision.

The combination of a few activities’ impact on a higher level can be more complicated than simply aggregating impacts. Effects should be considered such as synergies, replacement effects and backward and forward linkages (Knickel and Renting, 2000). The effect of synergy can for example result in a higher regional impact than simply aggregating effects.

### 2.3.2 The Impact of Individual Activities on a Region

It is suggested by Devuyst *et al.* (2001) that assessment should be applied to all sectors in society to make a difference. Sustainable development and socio-economic growth occurs through the contribution and impacts of many individual activities and the way they affect each other. The contribution of an individual activity is therefore important.

The potential role individual activities can have in reaching regional objectives can be seen from regarding four identified functions organisations can have in reaching ecological objectives and sustainability. The first function is that all organisations need to act towards sustainability ideals in order to reach a balance between individual achievements as a whole. The second function is grassroot innovation, where new ideas originate from individual organisations and sectors. These innovations can be new practices necessary for sustainability and ecological health. The third function is tied to specific regions. All regions have different ecological conditions inapplicable to other regions. Therefore, individual participation is necessary to ensure success/advancement in each region. Finally, accountability is important since it is believed that all actors in a system have a certain impact on the whole, even if it is after a specific actor is not present anymore (Jennings and Zandbergen, 1995).

## 2.4 Implementation Problems

There are many implementation problems surrounding environmental management and development planning objectives. Municipalities are sometimes overwhelmed with the complicated system of environmental management. Furthermore, strategic planning has implementation problems, because as it is often not compulsory it simply is not implemented.

### 2.4.1 Capacity Issues

South Africa's environmental and water policies are based on Integrated Water Resources Management (IWRM) principles and seen as some of the most progressive internationally. However, as mentioned by Anderson *et al.* (2008), progressive legislation and policies do not unfortunately guarantee progressive implementation as seen in South Africa's water sector. Solutions to the inadequate implementation usually include capacity building.

Kruger (2005) recognised the important role municipalities should play in development, especially environmental development. Municipalities are responsible for the management of a wide variety of tasks from infrastructure to the social and financial needs of citizens, to promoting tourism and balancing environmental problems. South African municipalities are overwhelmed by all the various legislative demands and often they are unequipped to handle complex environmental issues in addition to all their tasks. Kruger (2005) further states that municipalities' application of environmental management usually only involves the legal obligation of EIAs and environmental issues identified in IDPs.

Problems faced by municipalities cannot be solved by enforcing new policies and legislation, since the existing regulations are not implemented and adding more regulations would aggravate implementation problems (National Planning Commission, 2012, p. 436).

### 2.4.2 Unclear Strategies

Some municipalities are unaware of their legal requirements regarding environmental management and consequently many do not perform environmental management (Kruger, 2005). From an interview conducted by Kruger (2005), he derived that there have been suggestions that reform should begin with addressing the behaviour of municipalities. Another important action would be to simplify the complicated system of environmental regulations and frameworks applicable to municipalities.

Environmental frameworks form part of many different National Departments' functions, each having their own set of requirements for municipalities to comply with. It can be difficult to combine the various strategies and requirements. A simple tool regarding objectives set by all frameworks to make decisions can be useful.

Municipalities are required by the Development Facilitations Act of the Department of Land Affairs to create an IDP. IDPs are unfortunately mainly concerned with the planning process and not with the operations of their ac-

tivities (Kruger, 2005).

Sandham *et al.* (2013) also remarked that the different approaches and requirements for municipalities can create confusion for them. Kruger (2005) concluded that regulations are not enough to ensure that environmental management is being implemented.

### 2.4.3 Water Use Licences as an Example of Implementation Problems

All use of water apart from uses defined as Schedule 1 or general authorisations requires a Water Use Licence (WUL). Schedule 1 uses include small quantities of water mainly for domestic use, but also for other purposes such as for emergencies, for non-commercial gardening and some recreational uses. General authorisations permit the limited water use without a licence for certain uses. Reasons these categories do not require licences are to reduce administration work and the cumulative impact of these small uses is thought not to be too damaging to the aquatic ecosystems (King and Pienaar, 2011). However, the cumulative social impact might need further investigation.

Ever since the NWA of 1998 and the inception of a new WUL procedure, there has been an immense backlog of WULs (King and Pienaar, 2011). Some applicants have waited up to two years for a licensing decision. The decision-making process involved with issuing a WUL is very complicated and has initially been underestimated. An identified issue is a capacity problem in different spheres of government (Kotze, 2006; Colvin *et al.*, 2008). There have been various attempts to enhance the process and although progress has undoubtedly been made, there is still much room for improvement. One attempt at speeding up the process is exempting smaller water users from the licensing process. Usually the other efforts to improve the process involved adding more guidelines, tools and methods or assigning additional teams to solve specific problems. This type of approach would lead to another overcomplicated system in the water and environmental field.

The time delay associated with obtaining authorisation to use water and other actions such as discharging effluent, has a big impact on costs associated with starting a business. Internationally high costs of doing business have been recognised as having significant negative effects on economic growth (DWAF, 2008). Here an example of additional consequences caused by the time delay in the WULA process is illustrated.

Currently most WULs are being rejected because of socio-economic reasons and not environmental concerns or a lack of water (King and Pienaar, 2011).

The reserve determination and ecological impact stage of the Water Use Licence Application (WULA) procedure is very comprehensive and takes the most time. Here seems to be an opportunity to review an application's socio-economic impact before considering the quantity of water required.

The Bowman Gilfillan October newsletter (Mandlana and Lamola, 2010) shed light on the backlog of water use licensing. One of the problems caused by this backlog is the illegal use of water. Especially mines have a big impact on this as they are a big risk to water pollution and use water in large quantities. In July 2010 the estimated amount of outstanding water use licences was 1812. Of these, 220 were disposed of by September in that year. This means that it was returned to the applicant for revision and would later be added to the backlog again. This affects all industries requiring water use licences.

The DWA always states that the main reason for the delay and backlog is a failure to submit all the relevant information or consult interested and affected parties. Because the DWA is quick to use this as a reason to delay decision making applicants must be particularly careful to submit a complete application with all the relevant information in the first instance (Mandlana and Lamola, 2010). Another factor for the lengthy process is the reserve determination and calculations of water available for allocation (King and Pienaar, 2011).

In 2007, the concern of the time it takes to issue or decline to issue WULs was addressed. A DWA report (DWAf, 2007) providing guidance to ensure a uniform process in authorising water use was created. This report identifies the reason for the delayed process to be the confusing collection of methods used for decision-making. An assortment of non-uniform tools is used in the water-use authorisation process from guidelines and guides to different protocols and checklists. A task team was formed to standardise and streamline the process. However, six years later there is still a very big problem with WUL delays.

In 2010, the Letsema project was launched as an emergency response plan to the WUL backlog. The Letsema team was made up of members from regional and national government offices as well as from the private sector. A presentation by Ms Deborah Mochotlhi (the project manager of Letsema), on 16-17 March 2010 provides feedback on the progress of the project. By that time Letsema had dealt with 697 WULAs. 525 of these applications were from the Northern Cape of which 488 were declined. 1153 WULAs in total were sent back to applicants due to a lack of information (Mochotlhi, 2010). However, by October it was stated that in total 3039 WULAs were processed (Mochotlhi, 2010). In her budget speech on 21 May 2013, Minister Edna Molewa mentioned that of the 5349 WULAs received since 2001, 1063 still needed to be processed (Molewa, 2013).

The Letsema project has made big progress in the WULA approach in terms of diminishing the backlog of licence applications, but also in creating awareness in the DWA of processes required to perform this task. Even so, the approach is still not adequate. A more streamlined, integrated, coherent and pro-active approach is necessary according to King and Pienaar (2011). Involving the applicant in the process and making the procedures known to all applicants can also improve the process, as applications would be more complete and in line with approval requirements.

A checklist has been developed to assess compliance with all factors identified to be of concern with the issuing of WULs (Perkins, 2000). This checklist aims to make licensing less subjective, more transparent and structured.

#### **2.4.4 Compliance Issues**

Even if legislation is implemented by respected parties there would still be a problem with compliance. The compliance problem is not unique to South Africa and is struggled with worldwide. An identified problem area is in the Vaal River system where a vast volume of water is being abstracted illegally by irrigators (DWAF, 2009). There are also compliance problems concerning water quality, especially with mining activities.

Another issue is operations without water use licences. In the Limpopo Province there are 126 irrigations schemes (comprising 48 000 ha) active without licences (Matlala, 2009).

#### **2.4.5 Difficulty with Implementing Sustainable Development Ideals**

As a fast developing country with a history of social inequity, South Africa has more concerns than merely dealing with the reality of climate change and water scarcity. While trying to protect the environment and save water where possible, there is big pressure to alleviate poverty, undergo social reform, develop economically and provide food security for a rapidly expanding nation.

It is no surprise that different groups involved in water management each have a different priority in terms of the challenges the country faces. Somehow, all these factors need to be taken into account when allocating resources. Of course every activity also has a certain impact on all the mentioned problems. A balance should be met between meeting environmental concerns and developing the country to grow economically and eventually set social wrongs right.

Implementation problems also occur with individual development approaches, for example Local Economic Development (LED). LED is seen as an integral step in pursuing sustainable development. The ideals of LED are very promising, however there is great confusion concerning the implementation thereof (Abrahams, 2003).

The confusion surrounding the term “*sustainable development*” also contributes to the difficulty of implementing it. According to Chatterton and Style (2001), local and national governments are often unable to provide definitive guidance on achieving sustainable development. Specific targets would be helpful to enable everyone to strive towards a sustainability vision.

### 2.4.6 Unrealistic Visions

Plans need to take environmental concerns into account. For example, in Letaba catchment, agricultural development should be pursued according to the region’s IDP. However, water is limited. At some point there would not be enough water if the IDP goals are pursued.

## 2.5 Introduction to Small-Scale Farming in South Africa

In South Africa small-scale farming is usually found in former homeland areas where poverty is also widespread. Internationally small-scale farming has been identified as having the potential to improve rural areas greatly in providing income and job opportunities (Kirsten and Van Zyl, 1998). Small-scale farming provides many opportunities to improve conditions in rural areas, however certain constraints (especially environmental) should be kept in mind with the development of this sector.

### 2.5.1 Opportunities and Benefits

As mentioned poverty is common in rural areas (65% of poor people in South Africa lives in rural areas), however small-scale farming is seen as a possible solution to rural poverty (Machethe, 2004). Studies conducted by FAO and Machethe in Kwa-Zulu Natal and Limpopo both proved that the portion of rural population engaged in agricultural activities was less poor than those not involved in agriculture.

Apart from providing jobs and income, the provision of food is one of its major benefits. A community’s food-system is an important indicator of the health and sustainability of the community (Feenstra, 1997). Small-scale farming

directly impacts this food-system and can consequently have a significant contribution to the community's wellbeing.

Many studies have also shown that small-scale farming can be just as or more efficient than large-scale commercial farms (Heltberg, 1998; Lerman and Sutton, 2006). One of the reasons can be linked to the occurrence of small family farms as small-scale farms. At these farms the family members are usually the labourers on the farm and are involved very closely in all farming operations (Kirsten and Van Zyl, 1998). Therefore, they have stronger incentive to work hard than labourers on commercial farms.

Small-scale farming is supported by the government through provision of extension services (technical advice, information and training) and programmes such as the Comprehensive Agricultural Support Programme (CASP) and Micro Agricultural Financial Institution of South Africa (MAFISA). Various strategic planning documents also encourage expansion of small-scale farming such as the LED plan of Letaba and the ISRDS.

### 2.5.2 Constraints

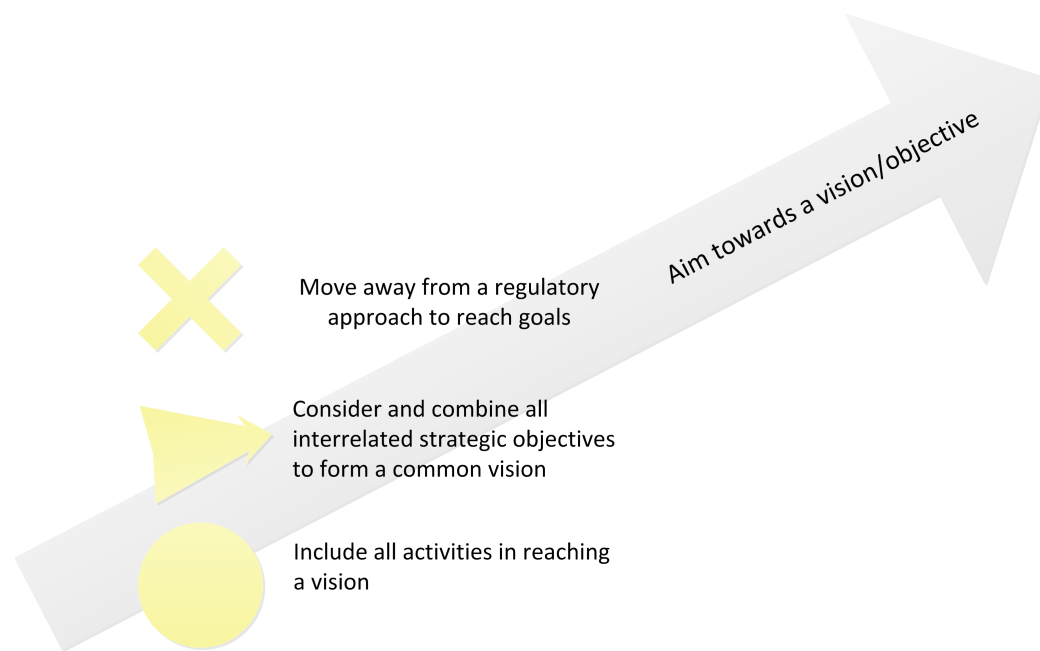
One problem with small-scale farming is the dependence on government, with programs such as Land Redistribution for Agricultural Development. Without involvement from the government progress would be difficult (Machethe, 2004). Access to farmer support systems is crucial to small-scale farming success.

Small-scale farming often uses inefficient practices and can damage the environment. In water scarce areas, efficient use of water is very important. The ISP of Luvuvhu and Letaba water management area states that no further surface water can be made available for development of small-scale farms. Other practices such as burning activities, improper nutrient management and waste management and lack of erosion control can also have impacts on the environment.

## 2.6 Chapter Conclusion

In order to reach a vision and strategic objectives, implementation structures need to be aligned towards a common goal. Figure 2.1 illustrates this concept of striving towards the same vision. The complex nature of strategic planning and environmental management in South Africa results in fragmented objectives and duplication of tasks. The approach to reach objectives should be "*objective-led*" rather than regulatory.





**Figure 2.1:** An Objective-Led Approach

WULA was used as an example of a process related to environmental management experiencing serious inefficiencies due to a complicated, fragmented process. A more streamlined, integrated, coherent and pro-active approach was suggested as a solution. Ways in which sustainable development is approached in South Africa was discussed. Certain positive actions were identified as well as inadequate measures.

The many groups involved in development planning and environmental management have different priorities. Again, the approach needs to pro-actively integrate their priorities. All functions and objectives need to be structured and defined.

All activities in an area have the potential to contribute to regional success and sustainability. Since small-scale farming is an important activity in rural areas and has the opportunity to make a difference to the wellbeing of rural people, it would be beneficial to align this sector to broad visions to make a better contribution.

## Chapter 3

# Integrated Evaluation of Small-Scale Farms

A method for evaluating the extent to which an activity aligns with strategic planning visions is developed in this chapter. Specific targets will be identified towards which all activities should be aligned to reach a common goal. The method would specifically be created for evaluating small-scale farms.

The chapter begins with a discussion on the proposed evaluation method (the Integrated Evaluation Model) and the structure thereof. The analysis of the identified strategic plans follows. The next section examines how the objectives of the identified documents can be integrated. The integrated objectives will then need to be reduced and adjusted to be applicable to small-scale farms.

To measure an activity against strategic objectives can be difficult, therefore criteria and indicators need to be derived to make objectives measurable. These indicators will be discussed, followed by the last section which mentions possible applications of the developed method.

### **Objective:**

Integrate the goals of different parties involved in regional planning and make it applicable for the evaluation of small-scale farms.

### **Research questions to be answered:**

1. How can individual activities be evaluated against broad strategic visions and objectives?
2. How can the objectives of the plans be structured to make it less effort to evaluate simultaneously?
3. How can these strategic documents be made applicable to small-scale farming?

### 3.1 Introduction

The main problems identified in the previous chapters can be summed up to the complex and interrelated collection of frameworks related to development, the environment and sustainability; the difficulty of implementing the visions of these frameworks; and lastly, problems with a regulatory approach to reaching sustainability objectives. An approach has been identified to solve these problems. This study recommends the development of a combined shortened evaluation method to assess an individual activity's alignment with all regional and national development planning visions and objectives. Hereby the contribution of an activity to the vision and sustainability of a region can be evaluated.

Initially the evaluation of any type of land development in accordance with regional planning is investigated. This evaluation framework is then reduced to be applicable to specifically small-scale farming as an activity. Eventually a customised framework to evaluate small-scale farms' contribution to regional vision and sustainability is produced.

According to the Department of Agriculture, Forestry and Fisheries small-scale farms are defined as farms that “*produce for household consumption and markets, earn revenue from their farming businesses as a source of income for the family. Farming is erratic and not always the main source of income; diverse non-farm sources of income exist to sustain the family. There is potential to expand operations and graduate to commercial farmers, if provided comprehensive support (technical, financial and managerial instruments).*” (Department of Agriculture, Forestry and Fisheries, 2011)

### 3.2 Proposed Evaluation

From studying the current practices in development planning and environmental management in South Africa a few problems as well as positive aspects were identified. The most important observations included:

- South Africa's environmental legislation and sustainability objectives are adequate, but there are problems implementing these strategies. Broad strategies are not implemented on local level.
- There are too many parties involved in environmental management and implementation.
- Unrealistic development goals are set.

This study suggests the development of a single model which aims to address all mentioned problems simultaneously. The primary aim would be to make the

implementation of South Africa's development visions easier, whilst combining the different frameworks and requirements of different levels and parties. Hereby, the aim of a more efficient process would be accomplished as well. The last problem would be addressed specifically according to environmental constraints.

It is proposed that for the evaluation of any type of activity all plans and programmes involved with development planning and with long term objectives would be included to truly assess whether a contribution is made to the vision for the area. For example, when evaluating small-scale farming certain strategic plans would typically be more relevant, such as the ISRDS or plans related to water, however a contribution and impact can be made towards the visions of any other plan. Ultimately, all activities in an area are interrelated and have a combined effect on the sustainability and success of the region.

The identified strategies and frameworks to measure contribution to regional planning and sustainability are the IDP (District or Local Municipalities), ISP (Department of Water Affairs) or CMS (Catchment Management Agencies), NFSD (Department of Environmental Affairs), NDP 2030 (National Planning Commission) and ISRDS (Department of Land Affairs), as seen in Table 3.1. For all regions in South Africa the criteria specified for the NFSD and NDP 2030 would be the same, whereas other documents would differ by region. WAR (Department of Water Affairs) is also included although it is a programme to address inequity rather than a strategic planning document. The IDP for the Mopani District Municipality was regarded and the ISP for the Luvuvhu and Letaba Water Management Area.

The National Water Resource Strategy (NWRS) is not included as all CMSs are required to be based on the NWRS.

**Table 3.1:** Focus Areas and Level of Relevant Frameworks

<b>Framework</b>	<b>Focus Area</b>	<b>Level</b>
NFSD	Sustainable Development	National
NDP 2030	General	National
ISRDS	Rural Development	National
IDP	Sustainable Development	Municipal
SDF	Sustainable Development	Municipal
LED	Economic	Municipal
CMS/ISP	Environmental	Catchment
WAR	Social	National

The implementation of the following factors should be ensured with the approval of activities in an area:

- Sustainability in terms of all spheres
- Integration of all frameworks and ideals from different departments and role-players

Sustainability forms a part of the objectives of all of these documents. However, measuring to what extent an individual activity aligns with the sustainability objectives and other goals of strategies of a region can be complicated. When evaluating the sustainability of a system or the contribution to sustainability of a part of a system, a complex analysis is required. Appropriate time lines, scales and indicators need to be chosen (Becker, 1998). Satisfying the intentions of all relevant strategies, plans and regulations can be even more difficult. Other considerations such as WAR, ISRDS and all relevant legislation need to be taken into account as well.

It has been observed that although all environmental legislations and frameworks are interrelated, they are not being implemented separately. In the case where various parties are affected, those parties would be consulted as part of the process. Instead of confirming compliance with each strategic document as part of an evaluation process, a generic tool combining goals and requirements of all relevant documents can be used to assess proposed (or existing) activities. Such a method can be used as part of different processes and make activities from different sectors or areas comparable to each other. Combining the NFSD as part of the assessment, would contribute to the achievement of sustainability objectives at implementation level and not just at strategic level.

Furthermore, by integrating the frameworks before going through with processes such as WULA, problem areas of the activity can be identified before going through a strenuous process.

It would also ensure that the national and provincial strategies are adhered to on a regional scale. At implementation level, different parties often have different priorities when it comes to environmental legislation and water allocation. A uniform objective is required to ensure fairness and effectiveness whilst reducing confusion and complexity.

Sustainable development already forms part of South Africa's long term strategy. However there is a need for a method that can be used with existing legislation and frameworks. Here are a few ways in which an integrated evaluation method would improve current procedures:

- Making the combined assessment of sustainability spheres possible
- Supporting the implementation of strategic objectives
- Enabling the evaluation of strategic objectives
- Allowing for more efficient existing processes such as WULA, LUMS, impact assessments and development planning.
- Making evaluation accessible for more role-players
- Making activities comparable to each other
- Allowing for a distinction to be made between areas

To create an improved evaluation tool for assessing activities in an area, it would first be necessary to look into the current related policies and strategies in more detail.

### 3.2.1 An Integrated Evaluation Method

The current evaluation method would entail comparing the activity under question against all relevant strategic documents and regional planning as illustrated in Figure 3.1<sup>1</sup>.

This method can be very time consuming and requires much effort. Different contributors might be necessary to perform the evaluations and many of the evaluations require duplicate work to be performed. A combined evaluation method that provides the same (or improved) results using less effort is proposed.

The proposed method of integrated evaluation is illustrated in Figure 3.2. This method only requires one evaluation of the activity, but would deliver results on its conformance with all identified strategic documents and programmes as well as an evaluation on social, environmental and economic impacts. The new integrated evaluation method would require less input effort and would provide more results.

The process followed to construct the improved integrated evaluation method is illustrated in Figure 3.3 (Steps 6 and 7 show the output process of Figure 3.2). Steps 1 to 7 are explained below:

---

<sup>1</sup>The colours indicating the output in Figures 3.1 and 3.2 signify the level of conformance with any of the documents. Red indicates that the activity does not support the document's vision, whereas green indicates support and yellow indicates that the activity does not have any significant impact on the ideals as set out in the document.



**Figure 3.1:** Traditional Evaluation Method

**Step 1** (as discussed in Section 3.3) entails examining all the chosen strategic documents and identifying all criteria, strategies, suggestions and objectives to which activities in an area can contribute.

**Step 2** orders the information gathered in Step 1 into sensible categories (social, environmental and economic) to easier identify correlations and conflicts and make it easier to use. More information on combining this information



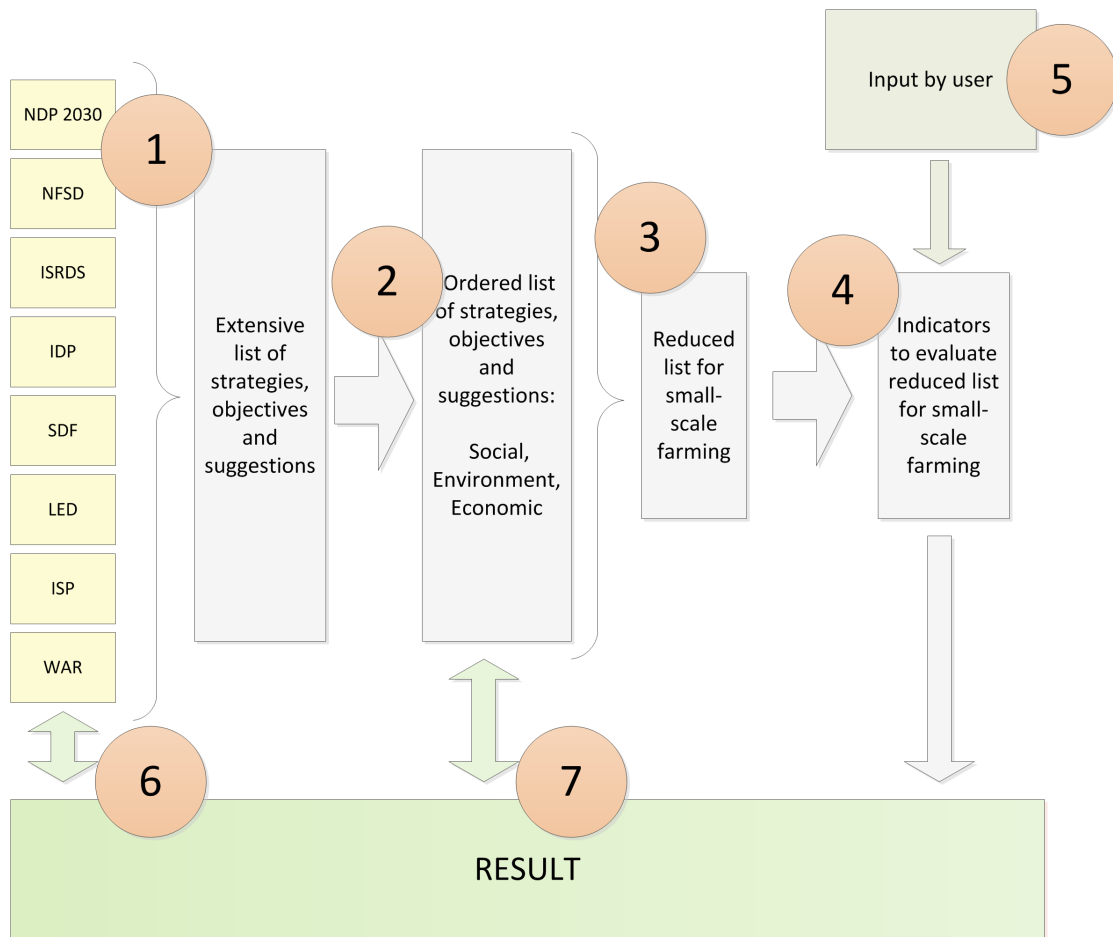
Figure 3.2: Improved Evaluation Method

can be found in Section 3.4.

**Step 3** reduces the list created in Step 2 into information that is applicable to small-scale farms. This step is discussed in Section 3.5.

**Step 4** involves ordering the information again, but this time in categories re-





**Figure 3.3:** Process of Constructing the Integrated Evaluation Model

lated to small-scale farming. The information is now converted to specifically deal with this sector. All of the criteria can be found in Section 3.6

**Step 5** deals with the information required by the user to assess the activity against the criteria identified in Step 4. Section 3.6.5 explains all the required input data.

**Step 6** provides the output against each of the strategic planning document.

**Step 7** shows the rating of the activity against each of the three sustainability spheres as organised in Step 2.

### 3.2.2 Structure of the Integrated Evaluation Model

The Integrated Evaluation Model tries to minimise the input effort of the person evaluating an activity, by tailoring questions specific to the type of activity and by making it regionally appropriate. This is done by considering related information from all the necessary plans and programmes. Duplication of questions and evaluations applicable to more than one framework would also not occur.

The location of the activities would identify the applicable municipal area, catchment area, quaternary catchment, SWAT HRU and information about the road network. Hereby, the applicable IDP, ISP/CMS, growth points, zoning information, ecological and hydrological information can be gathered. Natural heritage sites, natural park or protected areas should also be considered when evaluating a proposed activity.

From here a list of questions, categorised in environmental, social and economic impacts are provided. The topics are further divided to be made specific to small-scale farming. The subcategories are: General Information, Crop Information, Irrigation Information, Social Information, Rights and Safety at Work, Market Information, Farming Practices and General Operations, Transport and General Environmental Impacts (discussed in Section 3.6.5). All the information input by the user relates to specific criteria listed in any of the concerned frameworks.

## 3.3 Strategic Planning Documents

This section investigates the specific goals and criteria set out in the mentioned documents in order to find correlations, conflicts and repetition. All of the examined strategic frameworks have different requirements applicable to activities in an area. The goals and criteria that are selected are those to which an individual activity can make a contribution. Each document is discussed briefly, stating its main purpose and objectives that might be translated to activity level.

Since the goals of each area are so different it illustrates why the evaluation of proposed developments and water uses are complicated and why all these frameworks are not always consulted when evaluating an activity. However, this information is available and should simply be converted to easily accessible formats.

### 3.3.1 National Development Plan: Vision for 2030

The National Development Plan 2030 (NDP 2030) has a certain vision for the status of South Africa in 2030 and uses the document to come up with strategies to reach that vision. All strategic plans by government departments are required to be aligned with the National Development Plan 2030 (NDP 2030), which is seen as the golden thread linking strategic goals. The success of reaching the 2030 vision is dependent on the actions carried out by provincial and municipal level governments. A 2014-2019 Medium Term Strategic Framework will be developed to guide these parties.

The objectives of the NDP 2030 are grouped into the categories listed below:

1. Economy and employment
2. Economic infrastructure
3. Environmental sustainability and resilience
4. Inclusive rural economy
5. South Africa in the region and the world
6. Transforming human settlements
7. Improving education, training and innovation
8. Health care for all
9. Social protection
10. Building safer communities
11. Building a capable and developmental state
12. Fighting corruption
13. Nation building and social cohesion

Detailed descriptions of objectives under each category are provided in the document with realistic strategies on how it can be achieved. It is important to include these objectives in the evaluation of regional activities as the success would depend on the contribution of everyone. Although regional strategies will be aligned with these objectives, it is still a new document and the vision is not included in all strategies yet.

### 3.3.2 National Framework for Sustainable Development

On a national level the National Framework for Sustainable Development (NFSD), developed by DEAT, provides guidelines for pursuing sustainability in the country. This would be one of the first frameworks to consult when assessing activities, to determine whether it agrees with the national level strategy. One of the purposes for the development of the National Framework was to address the gap between all the various strategies and programmes which includes sustainable development principles (DEAT, 2008). That is also a goal of this thesis and is consequently another reason to make the framework an

important part of the assessment.

As it is a national level framework, this part of the evaluation would be the same for different regions. Assessing the sustainability of an activity is very useful since it would then be clear what the expected impact on the social, environmental and economic spheres would be respectively. Since all regions differ according to the balance between the three sustainability spheres, this result can be used to aim towards a balance.

The first step towards implementing the NFSD is the National Strategy for Sustainable Development and Action Plan (NSSD 1). The NSSD 1 specifically suggests a sustainable development strategy to be consulted with the allocation of resources (DEAT, 2011). This document includes many indicators to set targets as well as measure performance of the implementation and action plan. The indicators which might be impacted by activities were identified and used as part of assessment. Hereby it can be evaluated whether an activity supports or opposes the pursuit of national sustainability goals.

The five priorities of NSSD 1 are:

1. Enhancing systems for integrated planning and implementation
2. Sustaining our ecosystems and using natural resources efficiently
3. Advancing towards a green economy
4. Building sustainable communities
5. Responding effectively to climate change

Most goals, interventions and indicators of NSSD 1 are on a strategic and management level and not directly implementable with regards to specific activities. Guidance for the development of management plans is provided. A few factors included in the NFSD which are related to the topic of this study are mentioned here:

- Addressing the WUL backlog
- Stricter invasive plant management
- Desalination and water harvesting in appropriate areas
- Promoting conservation farming, permaculture and organic farming
- Increasing support to urban good growing initiatives
- Introducing schemes that enable the very poor access to education, health facilities, resources and prosperity

- Black Economic Empowerment (BEE) programmes and gender mainstreaming
- Support of local tourism
- Encouragement of sustainable production of traditional medicines

(DEAT, 2008)

The Green Paper on National Climate Change Response (DEAT, 2010) discusses the use of incentives and disincentives (such as regulations, fines and taxes) to strive towards a lower carbon country.

### 3.3.3 Integrated Sustainable Rural Development Strategy

The vision of the Integrated Sustainable Rural Development Strategy (ISRDS) is to, “*attain socially cohesive and stable rural communities with viable institutions, sustainable economies and universal access to social amenities, able to attract and retain skilled and knowledgeable people, who are equipped to contribute to growth and development*” (Department of Land Affairs, 2000).

The ISRDS was introduced in 1999 to address some of the problems not covered by the Reconstruction and Development Programme (RDP). It included service development, integration of local governments, ensuring that growth is approached in a sustainable way and the involvement of stakeholders (Kole, 2005). The objective is to help alleviate poverty by assisting rural people to create opportunities themselves, improve their own circumstances and care about success (Department of Land Affairs, 2000).

The main characteristics of the ISRDS was summarised by Kole (2005). Firstly, it is specifically focused on rural areas, rural economic development and making these areas less dependent on urban areas. Secondly, the development process should be sustained by enabling the rural population to play an important part in the development. The third feature is the integration of all the role-players. The fourth aspect is to base programmes on the growth dynamics of the area, attention should be paid to spatial dynamics as well as certain sectors with potential to bring improvement. The final feature focuses on social programmes to improve circumstances of people living in previous homeland areas.

### 3.3.4 Integrated Development Plan

An Integrated Development Plan (IDP) can be seen as the business plan of a region. The aim of an IDP is to plan development in such a way that improves

the lives of the people in the area. Each plan must be unique with regards to the available resources and regional problems experienced. Some of the IDP's intentions are in line with that of this thesis, e.g. speeding up implementation and organising co-ordination between spheres of government.

An IDP identifies certain development goals specific to the municipality. Proposed and existing developments should be evaluated against these goals to see whether it fits in with the vision of the municipality.

Integration with other national objectives is used in determining IDPs such as the Medium Term Strategic Framework (MTSF) goals of the National Policy Directive and the Provincial Growth and Development Plan (PGDP). For example for the development the Cacadu District Municipality's IDP, 16 internal documents and strategies were used (Cacadu District Municipality, 2012).

Most IDP objectives are associated with specific projects to be performed by or in collaboration with the Municipalities. However, an IDP provides insight into the vision of the municipality and general development objectives.

According to the vision of the IDP of Mopani District Municipality, it strives to develop the region's agricultural sector. This area has a very high rural population with many subsistence farmers. Delius and Schirmer (2001) investigated rural poverty and the important part agriculture used to play in reducing this poverty. Their study supports Mopani District Municipality's agricultural ambitions. However, even with the availability of arable land other constraints might prohibit agricultural objectives, such as some rural poor who have not been exposed to agriculture for decades and are unequipped. Also, water constraints are very important.

The Greater Tzaneen Municipality which forms part of the Mopani Local Municipality has a vision "*to be the fastest growing economy in Limpopo where all households have access to basic services*" (Greater Tzaneen Municipality, 2009). Here it can be seen that within the Mopani region, there are areas with different ideals and development objectives. Since agriculture does not have the biggest contribution to GDP, this would not necessarily be the sector of choice for this area, in contrast with the wider region's vision.

In the Mopani District Municipality, an important concern is alleviating poverty by providing better services to the poor and providing opportunities. Activities providing job opportunities and training for employees would typically be aligned with this vision. Addressing the vision of increasing food production, any activity involved in the agricultural supply chain would be beneficial. However, specifically in the Tzaneen area, activities with high GDP contribution would be preferred according to IDP objectives.

The Spatial Development Framework (SDF) and the Local Economic Development (LED) strategy were used to guide the development of Mopani District municipality's IDP. National strategies and Programme of Action were also kept in mind with goals such as reducing unemployment.

#### 3.3.4.1 Spatial Development Framework

A Spatial Development Framework (SDF) is an important component of an IDP which provides information on the location and type of development to be pursued. SDFs play a role in guiding allocation of municipal funds as well as investments from the private sector (Department of Rural Development and Land Reform, 2011).

Information in an SDF is divided into three groups (biophysical, socio-economic and built environment). The biophysical group (i.e. soils and geology, climate, hydrology, topography, biodiversity, vegetation, mining, agriculture) provides the resources of which the following groups are dependent on. The socio-economic components (i.e. heritage, demography, growth trends, education, health, employment, crime, income and poverty, economy, investment, tourism, land reform) reflects on the biophysical conditions spatially and provides context for the built environment (i.e. urban settlement, transport, housing, water supply, sewerage, solid waste, telecoms, energy) (Department of Rural Development and Land Reform, 2011). All of this information is available for each municipal area in visual formats and is an important part of development planning.

#### 3.3.4.2 Local Economic Development

The Local Economic Development (LED) provides insight into local development opportunities for economic growth. It guides governmental and non-governmental organisations, local communities and business and private sector partners to pursue economic growth and job creation. Numerous development programmes are proposed, divided into groups of similar nature (e.g. tourism development, development of agriculture value chain) (Greater Letaba Local Municipality, 2006).

Under each category a number of programmes are proposed, each with a few specific implementable projects to achieve it. For example in the Great Letaba Municipality, under tourism development the first project is "*Development of Modjadji and environs as tourism icon*". There are then nine projects mentioned to achieve this goal including upgrading of specific services, development of a camp site and activities such as visits to a sangoma (Greater Letaba Local Municipality, 2006).

### 3.3.5 Catchment Management Strategies and Internal Strategic Perspectives

A Catchment Management Agency (CMA) is responsible for water management on a catchment level. CMAs are the only institutions allowed to issue water licences apart from the DWA.

Each Catchment Management Agency has a Catchment Management Strategy (CMS) in which guidelines for water allocations are decided. These strategies are customized for every catchment. Before CMSs are developed by CMAs, DWA develops an Interim Strategic Perspectives (ISP) for each catchment area to guide CMAs until they prepare more detailed and improved CMSs<sup>2</sup>. The ISP of an area would include objectives and principles of the NWRS and WMA reports as well as national legislation and policies such as the NWA. Water allocation can be important in determining economic growth in a region. A sector having higher water allocation priorities would more easily grow economically. Determining these allocation rules can be very complicated as each sector has different economic and employment contributions per unit of water. According to the Breede-Overberg CMS, water allocation can help to improve social inequities. This can be done by allocating water to users who create stable or higher income employment or by allocating water to emerging farmers (BOCMA, 2010). The Breede-Overberg CMA also acknowledges “*water as the engine of development in the Breede-Overberg area*”, which is an important perspective in all water scarce areas. To pursue social equity, allocation reform focuses on projects for Historically Disadvantaged Individuals (HDI) (as discussed in Section 3.3.6).

The ISP of the Luvuvhu/Letaba WMA contains detailed information on the area regarding available water supply and water uses. Issues are also addressed such as the deficit experienced in the Groot Letaba catchment, the possibility of additional mining activities in the area and obligations towards the Kruger National Park for an adequate water supply.

Generic water management objectives summarised in the Luvuvhu/Letaba ISP include the consideration of international water obligations, the ecological reserve and maintaining a certain water quality. Water is to be used equitably for economic growth and to help in addressing poverty issues (DWAF, 2004). Certain objectives for water management are also discussed. For example, currently the amount of water abstraction is very unclear and a monitoring system is required (both for ground water and surface water, the quantity and amount is needed). This shows how it is necessary not only to monitor and license large water users, but rather all users, in order to establish the signif-

---

<sup>2</sup>Therefore, in this document, when referred to a CMS it might refer to an ISP, depending on the catchment under consideration.



icance and cumulative effect. The lack of operating rules in the area is also addressed.

Since there are already deficits and over-allocation in parts of the Luvuvhu/Letaba area, reserve allocation and transfers to Polokwane need to be reviewed. To address this issue a system of compulsory licensing will be investigated (DWAF, 2004). The allocations of some existing lawful users need to be investigated to determine whether the water is over-allocated. Proper validation and verification of all current water users in the Groot Letaba Catchment must take place to ensure the lawful use of water.

In the section dealing with smallholder irrigation schemes, it is mentioned that no additional water from surface resources will be available to smallholder irrigation schemes since water is already fully allocated. However, there is a programme to transfer schemes to some emerging farmer groups located in former homelands. In total there are almost 5 000 farmers occupying 6 720 hectares.

The collaboration with other departments is pursued for integrated planning. The identified departments are: Department of Environmental Affairs, Department of Agriculture, Department of Energy and Mineral Affairs and Department of Health.

The ISP also confirms that no additional allocations can be made in either the Groot Letaba catchment or Middle and Klein Letaba catchments. Even if the Tzaneen Dam is raised this would only ensure that current demand is met. The building of new farm dams would also be prohibited.

### **3.3.6 Water Allocation Reform**

Although Water Allocation Reform (WAR) is not a strategic planning document it was included in this study, because it is a policy with a strong social aspect dealing with an environmental resource. Therefore WAR is very applicable to small-scale farming, especially in a water scarce area.

WAR is based on the purpose to make water available to all South Africans especially since water might soon be fully allocated. Water should be allocated to uses which benefit the public. Long term strategies of WAR are to allocate the majority of water to black South Africans and at least half to women (Msibi and Dlamini, 2011).

## 3.4 Integrating Objectives

Combining all the relevant strategic planning and sustainability objectives into one evaluation method would ensure that all these factors are considered in decision-making. Also, unnecessary duplication would be avoided.

A method that combines the objectives of various strategic documents relevant to sustainability and development in a region is discussed in this section. Since all the frameworks have an objective of sustainability or deal directly with one of the spheres of sustainability (i.e. economic, social, environmental), the objectives of the new method are combined and divided into those three categories rather than into the objectives of the eight documents.

### 3.4.1 A Combined Evaluation

Objectives and requirements of the identified frameworks are often vague, difficult to implement, contradictory or repetitive. The complete list of these objectives and requirements totals to almost 200. Evaluating an activity against this list can be seen as the traditional evaluation method (as shown in Figure 3.1).

Many of the objectives of the included frameworks are general and vague statements, difficult to implement directly, such as “*creation of a better Africa and a better world*” in the IDP of Mopani District Municipality. Other objectives which are difficult to implement are statements about sustainability. Sustainability is an unclear term with many definitions, merely stating that sustainability should be pursued is not a clear enough objective. Whether sustainability is indeed achieved would depend on the cumulative effect of all activities in a region, therefore it is indeed necessary to be able to measure sustainability and whether there is a movement towards sustainability goals. The ISRDS, IDP, ISP and NFSD all mention sustainability. Another common, but vague objective is growth, mentioned both as social and economic growth. The measurement of some of these concepts is discussed in Section 3.6.1.

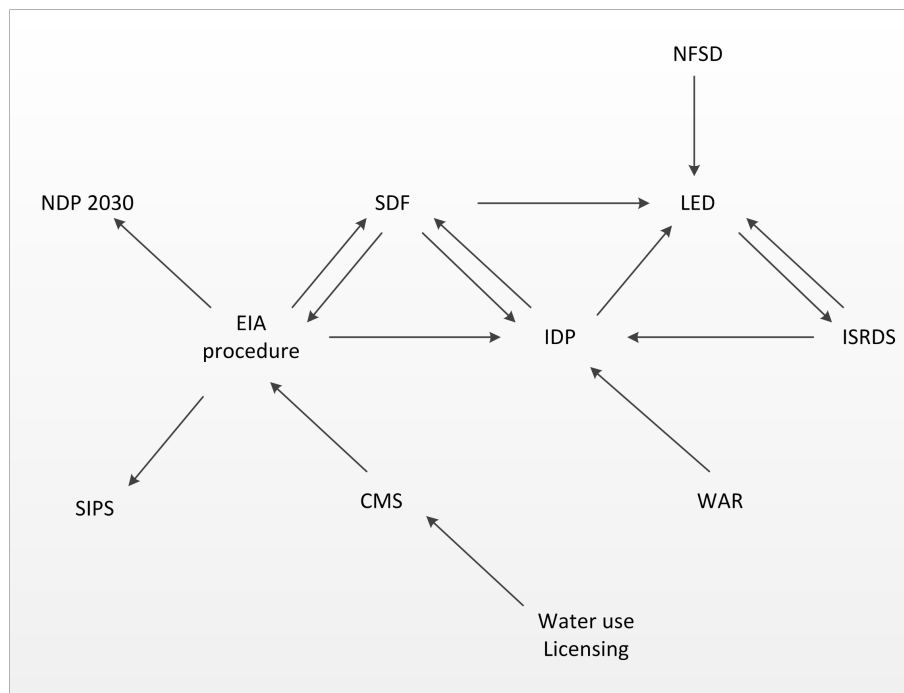
There are also discrepancies between the different frameworks. The ISP of the Luvuvhu and Letaba Water Management Area indicates that there is no additional surface water available for small-scale farming, however the LED of the same region promotes the expansion of small-scale farming. Furthermore, development on potential agricultural soil should be prevented according to the SDF even though the expansion of any agriculture seems unlikely, because of limited water availability.

Mining is also encouraged in both the IDP and LED despite the fact that mines use large quantities of water and the ISP states that there is currently

not enough water for additional allocations.

Other aspects are repeated in many frameworks making it redundant. For example, the NFSD, LED, IDP and SDF all have sections encouraging the growth of tourism in the area.

Since the various frameworks are related and should strive towards a common goal, there are often references to other frameworks instead of repeating information. The SDF and ISP require EIAs and EMPRs to be undertaken under certain circumstances. However, a basic EIA specifies compliance with SDFs and IDPs. The NFSD requires programmes to be launched in support of LED objectives. The SDF requires all plans to be aligned with the IDP, and the ISRDS expects the IDP to ensure integration. The WULA process has its own requirements, but should adhere to the conditions as set out in the applicable CMS. Direct references between the studies frameworks and processes are illustrated in Figure 3.4.



**Figure 3.4:** Interrelated Frameworks and Processes

There is always a trade-off when selecting a certain development over another. For this reason it would be advisable to regard all factors simultaneously and clarify all compromises. For example, land redistributions are an important objective in providing access to improved quality of life for people. However,

this land could have been used for highly economic productive uses which could have provided valuable job opportunities and also lead to improved quality of life (Mopani District Municipality, 2013).

Apart from the duplication and contradictions between the numerous relevant frameworks and plans, it is very time consuming to collect all the frameworks and go through the lengthy and complicated documents in order to establish whether a specific activity is aligned to all the identified objectives. It is also difficult to translate the information in these frameworks to information related to specific activities and developments. This information needs to be transformed to criteria or measurable requirements in order to make implementation of the frameworks easier and clearer. In the end the summation of individual activities makes up the success in an area and should all strive towards the same goals.

Certain criteria and sustainability indicators need to be developed that address all the crucial requirements and objectives of all relevant documents. These criteria would be spatially adjusted according to the catchment area, municipal area, spatial development nodes and hydrological units. Evaluating an activity according to these criteria would provide insight into the conformance with each mentioned document as well as an overall idea of its alignment with the regional planning vision and sustainable development.

### **3.4.2 Spatial Evaluation**

Constraints and opportunities that are specific to an area are identified in the IDP and SDF. Important factors would be the identification of national parks, national heritage sites and ecological sensitive areas. Municipal growth points and zoning (which are areas proposed for development) should also be considered. Zoning would include areas specifically allocated to agriculture. Site specific hydrological information could also affect activities.

### **3.4.3 Environmental Objectives**

An important aspect of environmental criteria would be the availability of water and the impact an activity would have on water supply. This impact would differ significantly according to specific locations and can therefore be a complicated task. Readily accessible hydrological information would be greatly beneficial in making quicker and more informed decisions. For the specific area under discussion, hydrological information is indeed available (detailed information is provided in Chapter 4) and specific locations can be assessed based on site specific water conditions and impacts.

Many environmental concerns would vary considerably according to a region, for example ecological sensitive areas. Other criteria would be carbon emissions, waste control and other forms of pollution.

The chosen frameworks specifically prioritising environmental concerns are the CMS or ISP. Other environmental objectives would be derived from sustainability requirements. NEMA guides environmental decision-making and contains important environmental legislation.

#### 3.4.4 Social Objectives

The framework focusing most on the social criteria is WAR. However, since sustainability is pursued, the social aspect of this objective should also be evaluated in a consistent manner.

Food security as well as malnutrition are major problems specifically in rural areas (Delius and Schirmer, 2001) and should be incorporated into decision-making criteria. Food security is defined as access to food (and specifically nutritious food), rather than the availability thereof. Supplying food to households, increased agricultural productivity, the cultivation of nutritious food crops and the creation of jobs would all contribute to food security (Lee and Neves, 2009). As an example, the cultivation of dry-beans or pulses can be beneficial to food security as it provides a protein component to the diet of rural people.

The transfer of water rights from Small-Scale Irrigation Schemes to mines (as in the Northern Cape) provides an interesting example of actions involving certain social trade-offs. Mines provide work, but mostly for males and would provide an income for their families. Whereas it is mostly women who would be the small-scale irrigation farmers (Perret, 2002). These farms would provide the region with food and contribute to the sustainability feature of “*self-reliance*”. Social aspects (gender equality), economic considerations, sustainability considerations and environmental considerations are involved in this situation.

#### 3.4.5 Economic Objectives

Economic growth is a common goal of most frameworks. However, as mentioned at the launch of the Employment Growth and Development Plan for the Limpopo provincial government by Pitsi Moloto, “*We cannot have growth for the sake of growth.*” He further elaborated that the economic growth experienced in the province does not translate into job creation and other benefits to social development. Measures apart from indicators such as GDP are necessary to understand growth. Approving activities for economic contribution

would depend on impact of other areas of sustainability and other parties in the region.

Specific economic opportunities are mentioned in the IDP, these opportunities would be logical to pursue in the region. However, the NFSD advises the diversification of industries for economic resilience. This would require regarding existing economic activities in an area continuously when approving new ones.

The support of entrepreneurs is encouraged by the IDP, Local Economic Development (LED), ISRDS and the NDP 2030. Entrepreneurs' contribution to economic growth has been proven internationally.

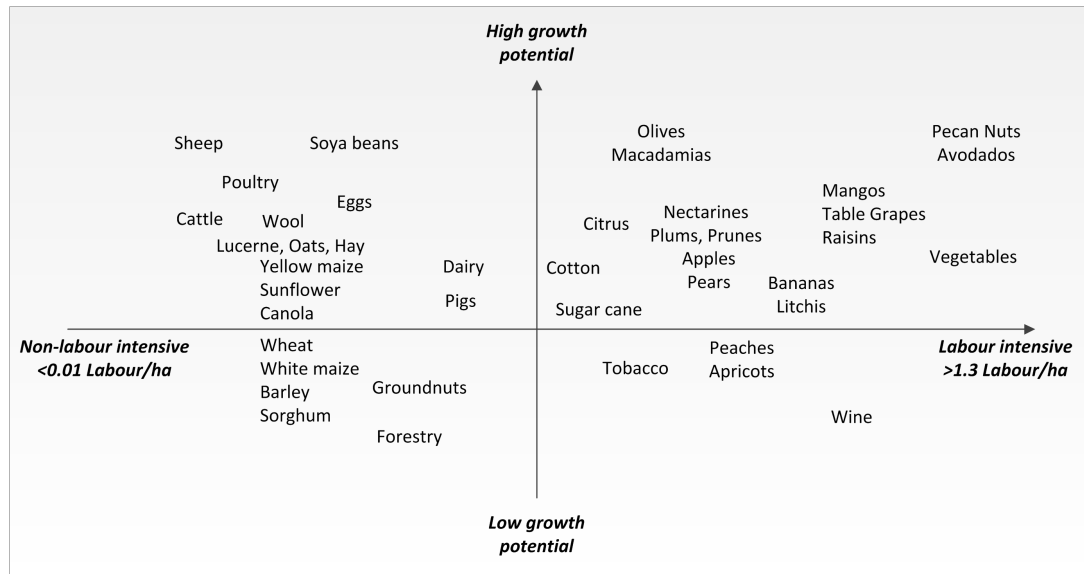
In rural areas, agriculture is usually the dominant sector and the sector with the highest growth potential (Department of Land Affairs, 2000). Agricultural related economic activities, such as agro-processing, should be encouraged in these areas. Certain agricultural products show higher economic and social growth potential. In Figure 3.5 the differences in job creation and economic growth between various products can be seen. This information should be taken into account with decision-making of the regional contribution of farms.

Access to natural resources is important in rural areas to improve livelihoods. The International Fund for Agricultural Development narrows down this access to the most applicable natural resources, which is land and water in the case of small-scale farms. Other natural resources include mineral resources, forests, fisheries, crop genetic resources and climate. It is important to distinguish between the availability of natural resources and the access to it (Lee and Neves, 2009). Often it is the rural poor without access to natural resources. Rights can help to ensure access to resources, e.g. water rights to ensure water for subsistence purposes.

### 3.5 Reducing Comprehensive Evaluation for Small-Scale Farms

After the identification of all objectives to which activities can make a contribution, the extensive list of objectives need to be reduced and made applicable to small-scale farms as illustrated in Step 3 of Figure 3.3. The main reduction is the elimination of all information related to other sectors, urban areas or programmes and projects to be managed and implemented by government bodies.

By exclusively assessing small-scale farms, many strategic ideals, such as becoming "*the food basket of Southern Africa*" are directly contributed to. The evaluation of whether it is a green economic activity is also disregarded. The



**Figure 3.5:** Employment and Growth Contribution of Agricultural Products. Adapted from: National Planning Commission (2012)

LED can directly be narrowed down to two agriculturally related programmes, i.e. “*Programme 1: Agro-processing focused on horticulture value chain*” and “*Programme 3: Expand existing agricultural production and projects*” (Greater Letaba Local Municipality, 2006). The whole EIA process can be disregarded for the evaluation of small-scale farming.

### 3.6 Indicators for Measuring Strategic Objectives

Measuring the compliance with certain objectives of the strategic documents can be more difficult to measure than others. Compliance with goals such as the inclusion of both men and women or the provisions of access to land can entail a simple “*yes or no*” answer. However when asked whether an activity aligns with goals of social inclusion or food security the answer would be more complex. Indicators need to be identified that measure contribution to such statements. The concept of complying with a “*vision*” is also difficult. Helling (1998) believes that in the case of planning, visions can be substitutes for concrete objectives, which explains why objectives and criteria need to be derived.

It is important to quantify certain criteria before the framework is reduced to identify whether a certain type of activity, such as small-scale farming, can contribute to the set criteria. However, other criteria would differ for each

type of activity and would only be made more detailed after the framework has been reduced.

This section begins by discussing the measurement of broad goals such as sustainability and economic growth. It ends with reference to the specific objectives identified in the strategic documents and which indicators are used to measure compliance.

### 3.6.1 Evaluating Complex Objectives

#### Measuring Sustainability

Since sustainability forms part of the objectives of most strategic documents studied as well as in the Constitution, it is important to evaluate contribution to sustainability. However, there is no clear method to approach the evaluation of sustainability. As discussed by Ravetz (2000), measuring sustainability is nearly impossible and has an endless amount of variables. However, since it is also very important to measure it in some extent, a very basic sustainability assessment is proposed with the aim to highlight areas where the evaluated activity might oppose the sustainability of the region. These highlighted problem areas can then be assessed in more detail.

Swilling (2008) comments on the contradicting development guidance for Local Government. IDPs pursue development while NEMA and EIAs measure and control the environmental impacts of developments. Although sustainable development is mentioned as an ideal in all of these documents and assessments, there is no clear definition or strategy of implementing sustainable development with measures such as re-use of resources and renewable energy. Swilling refers to this approach of the Local Government as a dualistic “*development-plus-impact-assessment*” paradigm.

There are also a number of indicator sets available<sup>3</sup> through which achievement of sustainable development can be measured. However, these measurements typically indicate whether a region is sustainable or highlight problem areas and would not indicate contribution of specific role players to the sustainability of the region. Although the EIA process can be seen as an evaluation of sustainability of a specific activity, it is biased towards environmental concerns (Hunt *et al.*, 2008).

---

<sup>3</sup>Examples of indicator sets include Environmental Pressure Indicators, Environmental Sustainability Index, Human Development Index, as well as broader sets such as the European Commission Sustainable Development indicators, the Commission on Sustainable Development indicators and the Green Growth Knowledge Platform indicators.



To measure sustainable development contribution, each activity should be evaluated in terms of their positive efforts (such as material and resources re-use, renewable energy, water saving actions and the use of recycled building materials) and not simply negative impacts. Other measures could be taken such as urging large energy consumers to use solar energy.

It is very difficult to select indicators as a comparable evaluation technique for sustainability as different activities would often have completely different information available or incomparable indicators. Ridaura (2005) believes it is impossible, but also undesirable to have a single list of indicators to measure all activities against because of the uniqueness of each situation. The Integrated Evaluation Model would however aim to measure each activity's sustainability contribution on a comparable way which is also easy to use. It is important to note that it is impossible to measure an activity's true value to sustainability, especially using a set list of indicators. The compromise has to be made between having a usable, simple and quick method that is less accurate or a more accurate method (but still not perfect) requiring a great deal of effort, expertise and time.

It is not within the scope of this study to come up with a detailed set of actions to measure contribution to sustainability as strived for by different levels of government. However, a few key aspects of sustainability will be assessed. DWA has a screening tool to measure the environmental impact as well as the socio-economic contribution a certain activity would make to an area (DWA). It should be expanded to be used more generally, since it is specifically developed for water use. A multitude of other tools have been developed to measure the sustainability of projects. 675 tools were reported to have been developed by 2005 to measure the sustainability of construction projects (Hunt *et al.*, 2008). Therefore, strong points of some of these tools can be assessed in addressing the evaluation of sustainability in proposed activities. Many of these tools are based on sustainability indicators as developed by the UN, EU and UK Sustainable Development Indicators (Hunt *et al.*, 2008).

Apart from the spheres of sustainability (i.e. social, economic and environmental), sustainable development has certain important features which describe the situation where a balance is reached between the three spheres. Ridaura (2005) identified eight characteristics of sustainability:

- Adaptability and (capacity for) innovation
- Equity
- Self-reliance of the region
- Stability

- Productivity
- State of social assets
- State of natural assets
- Green growth/green economy opportunities

By supporting the characteristics of sustainability a contribution is made. Therefore, these sustainability features would be considered in the evaluation tool. These features and their impacts on social, economic and environmental spheres are interrelated and will be evaluated as such. For example, it is said that the sustainable use of resources are the key for socio-economic growth and poverty eradication. According to this the “*State of natural assets*” are responsible for the “*equity*” and other socio-economic factors in the region.

### **Equality and Eradication of Poverty**

One of the main goals of WAR is the eradication of poverty and the promotion of equitable economic growth. Measures to be taken for the eradication of poverty were found in the United Nations Report on the World Social Situation 2010. It included concepts such as empowering women, education, property rights, increasing agricultural productivity and social protection. Factors such as equality and social inclusion are more important to reduce poverty than economic growth (Department of Economic and Social Affairs, 2009).

On this topic, the IDP addresses “*sustainable livelihoods*”. Ensuring sustainability of livelihoods, means to ensure that people (in particular the rural poor) can make livelihoods for their households. The most important aspects would be access to land and resources, as well as access to health care and education and the improvement of skills.

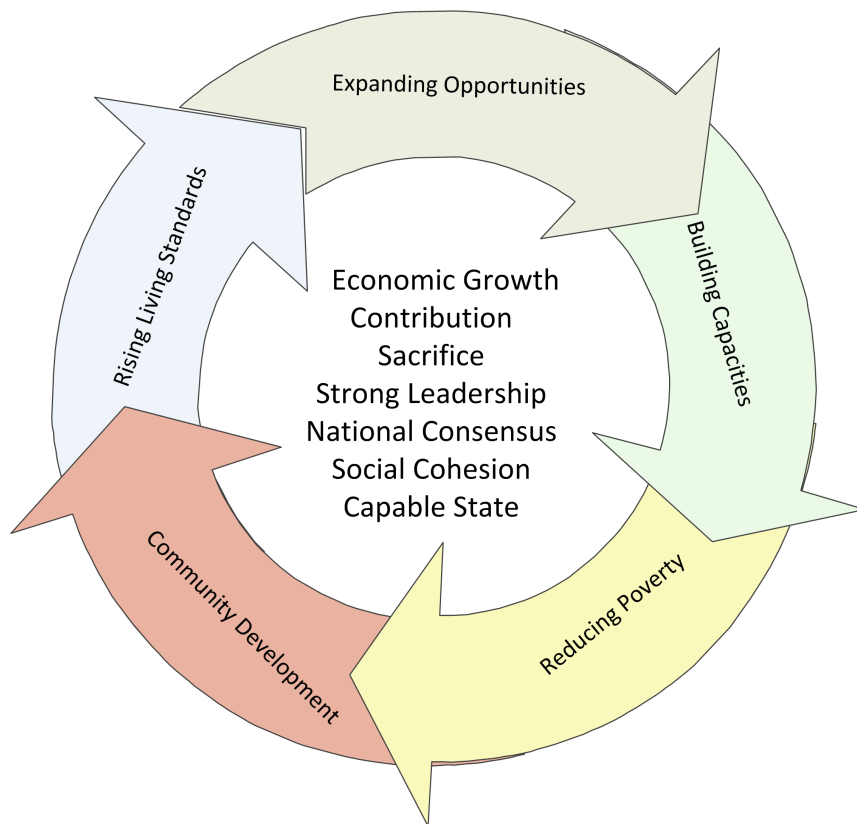
Ensuring decent work is another aim of the IDP. According to the International Labour Organization, decent work is the result of four objectives (International Labour Organization, 2013):

1. Creating jobs
2. Guaranteeing rights at work
3. Extending social protection (This would include safe work conditions, inclusion of both men and women and access to health care)
4. Promoting social dialogue

The Giyani IDP provides a few examples of how sustainable communities can be built. A few projects are planned to promote a healthy society (Greater

Giyani Municipality, 2012).

As stated in the NDP 2030, the various objectives of the National Vision are interrelated. Reaching one objective would often contribute to the achievement of another. Any positive action can contribute to the bigger picture. This concept is illustrated in Figure 3.6. Such a link is the eradication of poverty and economic growth (discussed in the next section).



**Figure 3.6:** The Virtuous Cycle: Interrelated National Objectives. Adapted from: National Planning Commission (2012)

### Evaluating Contribution to Economic Growth

The IDP provides clarification on achieving economic growth in the area. The focus should be on Local Economic Development and on creating jobs. Furthermore it is acknowledged that partnerships between different sectors and role players would be necessary, as it is not something to be achieved only through municipal efforts.

The IDP aims to ensure inclusive economic growth. This is a pro-poor objective and would be measured by opportunities for HDIs to participate in economic growth. Typically black entrepreneurs should be encouraged to reach this objective.

Projects as planned by the Greater Giyani Municipality's IDP such as the construction of market stalls at villages would typically contribute to economic growth (Greater Giyani Municipality, 2012). In rural areas development of agro-processing (as identified in the LED document), poses great potential by providing opportunities for the primary sector in turn. The social objectives are discussed first.

### 3.6.2 Criteria for Reaching Social Objectives

As discussed in the previous sections certain criteria need to be adhered to in order to comply with the objectives of strategic planning. This section discusses how contribution to specific objectives is measured by the proposed Integrated Evaluation Model.

These criteria relates directly to the plans in Step 1 and the list in Step 2 (Figure 3.3). Therefore, for easier referencing purposes it will here again be divided into the same categories of social, environmental and economic impacts.

#### (a) Inclusive Economic Growth

Inclusive economic growth implies the inclusion of Historically Disadvantaged Individuals (HDI) in economic activities. In the case of small-scale farmers, it is regarded as inclusive economic growth if the owner of the farm is a HDI. Inclusive economic growth is an objective of the IDP, LED, ISRDS and WAR.

#### (b) Job Creation

IDP and LED specifically mention job creation as objectives. Small-scale farms are known to create more jobs per hectare than large farms. In Brazil a study found 8 hectares cultivated land of small farms equated to one job (Food and Agricultural Organization of the United Nations, 2012). Data on the potato industry in South Africa estimates 1.2 jobs created per 1 hectare. A benchmark of two labourers per hectare is used as found in the NDP 2030 (National Planning Commission, 2012).

#### (c) Guaranteeing Rights at Work

This objective was measured against basic rights given to workers employed in the agricultural industry (The Agricultural Labour Act 147 of 1993). The IDP strives to guarantee rights for all workers.

**(d) Safe Work Conditions**

Agriculture is one of the most dangerous industries in terms of fatalities and injuries (Purschwitz and Field, 1990). The most common reasons for injuries, ill-health and fatalities in agriculture were identified through literature. The safety of the farm for workers is determined by the presence of these dangers as well as by the training to deal with these dangers and the ability to cope with potential accidents. Safe work conditions are prescribed by the IDP.

**(e) Inclusion of Both Men and Women**

If both men and women are employed on the farm this objective is met. The inclusion of both men and women is an ideal of almost all the documents studied: WAR, ISRDS, IDP, NFSD, NDP 2030 and CMS.

**(f) Access to Land for the Rural Poor**

It is assumed that all small-scale farms provide access to land for the rural poor. IDP, ISRDS, WAR, NFSD, SDF, NDP 2030 and CMS all realise the value providing the rural poor access to land.

Rural Development and Land Reform is closely related to this objective. It is also assumed that all small-scale farms especially in previous homeland areas contribute to rural development and land reform.

**(g) Access to Resources for the Rural Poor**

In this context resources required for agriculture would be water (and land as discussed in the previous point) to which all the small-scale farms have access.

Finance is another resource which can help small-scale farms to success. There are government grants available for small-scale farmers. In 2009 an average of R2500 were provided per small-scale farm household, however some farms received much more where others received none (Aliber and Hall, 2012).

**(h) Skills and Capacity Development**

Five indicators contribute to evaluation of skills development and capacity development. Firstly, it is enquired whether the farmer is skilled. This would specifically refer to proper training or experience. Secondly, any training currently received or planned that can contribute to the success of the farm is considered. Thirdly, it is assessed whether the farmers have any other skills apart from farming.

Since water is a fundamental aspect of agriculture and a scarce resource in South Africa, the productive use thereof can be an important contributor to the success of the farm. Consequently, the fourth measure

is whether the farm is part of a programme which provides knowledge on the productive use of water. This can be from Water User Associations, catchment forums, NGOs or the civil society. Finally, access to and benefiting from external knowledge, support or technical support is considered.

The development of skills and capacity building have the potential to help social and economic growth and can even have a positive effect on the environment. Since this is such an important objective with far reaching consequences most strategic plans includes skill and capacity development. Skills development of specifically women is also mentioned.

**(i) Food Security**

Food security is a much more complex issue than the availability of food. Much more important than producing enough food is to ensure that everyone has access to food. Furthermore, access to food does not ensure the proper nutritional values are obtained. A healthy diet is very important in food security. Productivity would be one indicator of food security, but others would be the provision of food to households, job creation and the supply of nutritious food. Food security is a goal of the IDP and NDP 2030.

Supplying food to the local community is a great opportunity in contributing to food security. Local food systems and moving lower in the food chain (i.e. a diet that considers the environmental impact of meat production and is therefore based on eating more grains and legumes and less meat) are important factors in securing food security (Lappe, 1975; Feenstra, 1997).

**(j) Engagement and Participation of Community**

This objective is measured by considering whether the farm is part of any community projects or co-operations. Although participation on a social level would also contribute to the ideal as envisioned by the IDP and ISRDS, here is concentrated on the agricultural activities of the farm. Therefore, it relates to the target of the NFSD of “*Supporting Alternative Business Models such as Co-operatives and Community Associations*”. These types of collaboration would however also contribute to community cohesion.

**(k) Diversity in the Workplace to Build Bridges between Communities**

This goal contributes to the ideal of sustainable and cohesive communities as mentioned in the IDP and ISRDS. Here diversity can refer to diversity in terms of race, language and religion (gender is already addressed in another section).

**(l) Social Inclusion**

Social inclusion is determined by the various groups of people involved in any way with the activities of the farm. The inclusion of women, youth, unskilled individuals, any HDI and poor people are considered. It is also explored whether the farm is involved in a diverse supply chain of buyers and sellers and part of a community project or co-operation.

In this instance diversity of buyers and suppliers would be reaching social inclusion objectives if they are from a different group than the farmers. However, when assessing other objectives it would be preferred that these suppliers and buyers are from HDI groups to encourage inclusive economic growth.

**(m) Black Economic Empowerment (BEE) programmes**

Employment information are required and indicates whether employees fall under BEE criteria.

**(n) Opportunities for Poor**

Again employment information indicates whether poor people are involved in farming activities.

**(o) Employment of Young/Unskilled Workers**

Any involvement of young and/or unskilled workers in farming activities would score positively in relation to this objective of the NDP 2030.

**3.6.3 Criteria for Reaching Environmental Objectives**

The criteria to which a small-scale farm must adhere in order to make a contribution to environmental objectives are discussed below.

**(a) Sustainable Resource Management and Use**

Resources in this case are land and water. It is assumed that land is used sustainably according to the SDF. Sustainable use of water is measured here according to water productivity, i.e. the yield obtained with each liter of water used. The CMS is the most important document in this regard, but the IDP, NFSD and SDF also specifically include sustainable use of resources as part of their vision.

**(b) Land Use to Full Potential**

It is assumed that all small-scale farms are on land allocated to agriculture according to the SDF and that this is done on principles ensuring land use to its full potential.

**(c) Recycling Initiatives**

The NFSD promotes recycling initiatives. Recycling that is applicable to small-scale farming and agricultural waste has been identified. Agricultural wastes are any products or substances from the premises of agricultural activities. Animal waste as well as chemical waste is some of the most common. Other waste includes packaging of fertilizers and pesticides and surplus products. Certain agricultural wastes can very successfully be used as fertilizers instead of commercial fertilizers, as an economic and environmental benefit. Other applicable recycling and waste initiatives include riparian buffers or structures to trap or retain waste to prevent contamination of surface water and groundwater; grey or recycled water for irrigation and renewable energy use.

**(d) Water Reuse**

Any reuse of water or desalination for use in farming activities are encouraged by the NDP 2030. SDF specifically mentions grey water to be used for irrigation, which would fall under this category. This criteria is also one of the sub criteria for the objective above (Recycling Initiatives).

**(e) Green Transport**

Transport can be used by the employees as well as to transport products to markets. The mode of transport in each instance is examined (walking, bicycle, animal carts, cars, taxi, bus, train, truck). Only the first three options would be considered “*green*” and public transport would be considered “*greener*” than private transport such as cars. The distance and frequency is also considered.

**(f) Renewable Energy**

If the farm uses energy from renewable energy sources such as solar or wind energy, it complies with this goal of the NFSD and SDF.

**(g) Climate Adaptation Strategies**

Strategies (applicable to small-scale farms) measured to deal with climate change are the diversification of crops, skills to perform other work besides farming and the use of any water use efficient technologies. This objective is found in the NFSD.

**(h) Threaten Biodiversity**

Although the removal of native vegetation is a threat to biodiversity, the only factor considered in this regard here is the use of pesticides which can be very harmful to biodiversity. Protecting biodiversity is also a NFSD objective.



**(i) Soil-Erosion Control**

Any measure taken to control erosion scores positive towards this criterion, contributing to the objectives of NFSD. Examples of actions are: mulch farming, vegetative hedges, conservation tillage, cover crops and engineering structures.

**(j) Water Use Efficiency Technologies**

As with soil-erosion control, any measure taken to use water more efficiently (apart from the type of irrigation, which is assessed separately) would contribute to this criterion. Compliance with this criterion would score positively against the NFSD, SDF, NDP 2030 and the CMS.

**(k) Nutrient Management**

If a proper nutrient management plan is followed, the farm complies with the objective of “*nutrient management*”. Typically this would involve expected yields (realistic yields), analysis of the nutrients in the soil and water<sup>4</sup>, monitoring of nutrients and identification of proper timing for application (United States Environmental Protection Agency, 2003). Nutrient management is regarded by CMS and NFSD.

**(l) Use of Existing Roads and Proximity to Town**

The use of existing roads and proximity to town/market are important in spatial planning. These criteria are measured separately since some villages are part of a road network, but far from any major towns.

**(m) New Farm Dam or Irrigation Scheme**

New farm dams and irrigation schemes are prohibited by the CMS therefore it would be necessary to identify whether the farms are complying with this criterion.

**(n) Water Use Licensing and Registration of Water Use**

Registering a water use help the responsible authorities to better manage water resources, especially in water scarce areas.

**3.6.4 Criteria for Reaching Economic Objectives**

The criteria applicable to small-scale farms to achieve the economic objectives are examined in this section.

---

<sup>4</sup>Therefore, if the soils are nutrient rich, fertilizers might not be necessary (this would also count as nutrient management).

(a) **Supporting Alternative Business Models such as Co-operatives and Community Associations**

See statement “Engagement and Participation of Community” under Social Objectives.

(b) **Creating Partnerships with Different Sectors and Spheres will be Necessary for Prosperity**

This statement is also closely related to the statement above, but refers specifically to partnerships between different sectors and spheres. The IDP believes such partnerships are necessary for the region’s prosperity.

(c) **Support Entrepreneurs**

For this study, any farmer selling produce to any market is regarded as an entrepreneur. IDP, LED, ISRDS and NDP 2030 all have the encouragement of entrepreneurship as part of their objectives since it can have significant positive impacts on the local economy.

(d) **Agricultural Diversification**

Agricultural diversification is a target of LED. It refers to the diversification of crops as well as the diversification of agro-processing.

(e) **Revitalisation of Irrigation Scheme Activities**

The revitalisation of previously developed irrigation schemes is encouraged by the LED plan.

(f) **High Technology Farming Practices and Methods/Increased Agricultural Productivity**

Studies by the Institute for Food and Development Policy in California have found that worldwide small-scale farms are more productive per unit area than larger commercial farms. They found various reasons for this higher productivity. One important factor is the complex farming systems often used by small-scale farms. Whereas commercial farms follow a system of one crop in an area, small-scale farms use mixed systems hereby using more space productively. Another factor contributing to higher productivity is by rotating land between livestock and crops. Manure from livestock serves as a natural fertilizer and parts of the plants not used for human consumption can be consumed by the animals.

Examples of new or technological farming practices typically achievable by small-scale farmers are listed. The use of any of these practices contributes to this objective as stated by LED, WAR and CMS.

(g) **Agro-Processing**

Agro-processing refers to agro-processing being part of the farming activities or to the supply of produce to local agro-processing businesses.

The development of the agro-processing industry is highly encouraged and many advantages are identified by the LED plan. Eleven agro-processing divisions have been identified by the Department of Agriculture, Forestry and Fisheries to be developed: food, beverages, paper and paper products, wood and wood products, textiles, wearing apparel, furniture, tobacco, rubber products, footwear and leather and leather products.

**(h) Local Supply Chain**

An important objective of LED is the supply to and from other local establishments. This objective is measured by indicating whether supplies are from local businesses and whether buyers of the produce are local.

**(i) Diversification of Economies**

Diversification of economies and industries for resilience are measured by evaluating whether any new or uncommon products, crops or services are brought to the area by the farm's activities.

**(j) Economic Growth through Natural Resource Use**

Any income obtained or saving of costs from using natural resources in the area can contribute to this objective. In the Letaba catchment area mopani worms and marula fruit are identified natural resources with economic potential. However, the use of natural resources to save costs such as the use of Mopani trees for trellising on farms is also contributing.

**(k) Crops with High Employment Potential**

Figure 3.5 indicates the employment potential of different types of crops. Crops are measured according to this figure.

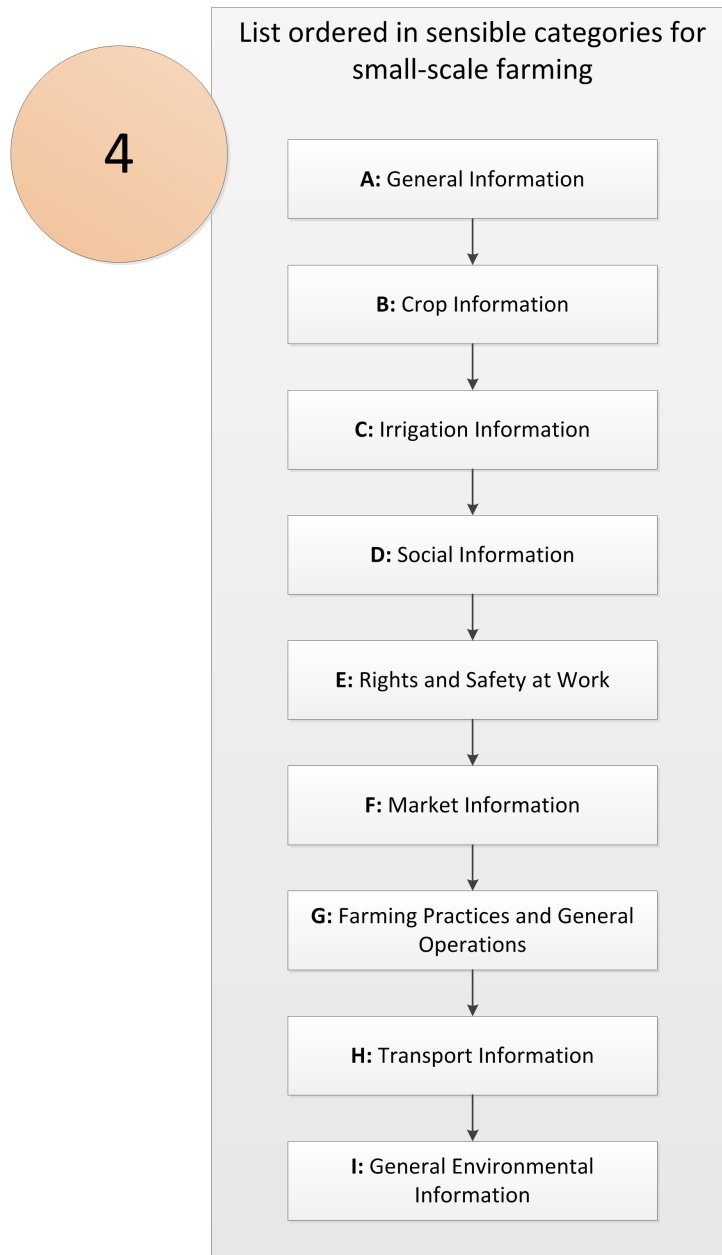
**(l) Increase Exports and Expand Trade and Investment**

To assess this criterion the market to which the farms supply is evaluated, i.e. local, national or even international. Although exports are unlikely at present, in the case of exports, relationships with other Southern African and BRICS countries are encouraged above other countries according to NDP 2030 goals. The growth potential of the crops as indicated in Figure 3.5 is also incorporated.

### 3.6.5 Input and Output Information

All of the criteria and objectives above (Sections 3.6.2 to 3.6.4) are answered by using information from 55 questions asked, as described below in Table 3.2. User input is minimised while user output is maximised. These nine input categories form the ordered list mentioned in Step 4 of Figure 3.3. Figure 3.7

contains the detailed information of Figure 3.3's Step 4. The user interface can be found in Appendix A.



**Figure 3.7:** Step 4 of Constructing the Integrated Evaluation Model

The information supplied by the user in Table 3.2 is translated into results regarding alignment with all the studied strategic documents and sustainability spheres. These outputs and the information used to assess them are briefly discussed below.

**Table 3.2:** Input Information for Evaluation

General Information	<p><i>General Information</i> is the name of the farm for easier identification, the location and the size of the farm. The location is necessary to determine the effect on water of the area as well as to identify applicable frameworks. The size is necessary to make sense of employment numbers and environmental impacts.</p>
Crop Information	<p>The different crops cultivated and the yield (tonnes) per hectare produced should be provided. From this information many assumptions can be made. From the type of crops information about the growth potential of that specific crop is available as well as the potential labour required to produce the specific crop. Certain crops also contribute more to food security than others.</p> <p>Crop information is consequently used to make up the scores for social aspects such as food security and employment potential as well as economic impacts.</p>
Irrigation Information	<p>For small-scale farming, <i>Irrigation Information</i> is the most important input to assess water impacts. The type of irrigation (sprinkler, drip or surface) is ranked according to efficiency. The source of irrigation water (surface, borehole, rainwater, alluvial) has an impact on hydrological processes and can be modelled in SWAT</p> <p>Other information is requested, such as whether a previously abandoned irrigation scheme is used, since the LED plan promotes this. The building of new farm dams is also included since this is discouraged by the CMS.</p>
Social Information	<p><i>Social Information</i> deals with the type of people (gender, age, level of education, race) included in the activity in terms of ownership, employment as well as contact in business activities (e.g. suppliers and customers). The number of jobs is compared to the size of the farm. Information about skill and capacity development is also required.</p> <p>Participation in community activities that would lead to sustainable communities is assessed as well as diversity in the workplace and business activities. This is also linked to access to external knowledge and skill development.</p>

---

Rights and Safety at Work	A few basic rights for agricultural workers are included to assess whether the workers would have received better working hours, wages and rights such as sick leave and maternity leave in other agricultural practices than on their small-scale farm. Certain dangers associated with agricultural work have been identified and need to be indicated if it is relevant to the specific small-scale farm. This would include factors such as dealing with dangerous machinery as well as work requiring inadequate postures. Proper training to minimise risks for certain dangerous activities are taken into account.
Market Information	<i>Market Information</i> is important to assess contribution to local economic development and part of the National Development Goals 2030. However, it is also important for dealing with the effects of climate change, e.g. diversification of industries. The IDP encourages involvement with specific economic activities. Supporting other business activities within the local municipality is part of the LED plan.
Farming Practices and General Operations	Certain farming practices such as rotating of crops and livestock, the use of pesticides and fertilizers and general practices such as recycling are dealt with in this section. This section contributes to mitigating environmental impacts, increasing productivity, as well as advancing agricultural technology practices.
Transport Information	Transport has an impact on the environment. The transport used by the employees and transporting products to the market is under question. The type, frequency and distance are required.
General Environmental Information	Any environmental impacts not assessed in one of the previous sections are included here. Burning activities contributing to air pollution, removal of native vegetation and measures to prevent soil erosion are assessed, as well as conformance with the SDF.

---

### 3.6.5.1 Alignment with Frameworks

All the questions directly related to a specific framework are identified and the activity is scored to whether it contributes to it or not. Since the framework is reduced to be only applicable to small-scale farms, the maximum number of criteria identified to be applicable to small-scale farms per document was 18 criteria for the IDP. The ISRDS has the smallest number of criteria, totalling to seven.

All of these criteria receive a score of zero or one and make up a final percentage score of alignment with each document. The layout of this output is in Appendix A.

### 3.6.5.2 Impact on Sustainability Spheres

The output for impact on sustainability spheres are ranked in scores from A to D, where “A” is the highest score and “D” the lowest. A score of “B” would imply that the performance to the specified criteria is acceptable, but can improve to the optimum score of “A”. “C” indicates that the score is not good enough, but not yet in the worst category of “D”.

#### Social Impact

The overall Social Impact score is comprised of seven subscores: *Opportunities, Employment Potential of Crop, Social Inclusion, Skills and Capacity Development, Rights at Work, Safety at Work* and *Household Food Security*.

#### Environmental Impact

The Environmental Impact score has five subscores. A *General Water* score, *General Environmental* score, *Recycling* score, *Biodiversity Impact* score and *Development Planning Alignment* score.

#### Economic Impact

Small-scale farming has a bigger impact on social and economic spheres than on the economic sphere, therefore this score only includes three subscores. These are the *Development of Local Economy, Expanding Trade and Investment* and *Climate Change Adaptation Strategies*.

## 3.7 Applications of a Combined Framework

Definitive objectives make it easier for everyone to align themselves with strategic visions. The nature of the proposed evaluation method encourages reaching strategic objectives as envisioned for the area, rather than simply minimising negative impacts without aiming towards a common target.

Apart from generally advising in what ways an activity can improve to be better aligned with strategic objectives, there are also a number of practical applications for the developed Integrated Evaluation Model.

- Especially in water scarce areas water uses will need to be reevaluated for reallocation. Having a quick method to evaluate an activity against all applicable frameworks would be very useful to see how it aligns with all relevant regional plans. As part of the current WULA process it would also help to save time.
- The Model would also have value in being used as part of compulsory water use licensing. The NWA states under section 42 that new and existing water users might be required to apply for licences. According to the Act it might be required to undergo environmental assessment and/or other forms of assessment. An integrated evaluation of alignment with the regional vision seems to be an ideal form of basic assessment for this purpose, as it would identify water users not contributing to the area's objective.
- In areas where development might soon be constrained by sustainability issues, potential activities would be approved by their ability to contribute to the sustainability of the area.
- Implementation of WAR would be benefited by such a method since one of the identified constraints of the implementation of WAR is the intensive nature of the licence review process (DWAF, 2007).
- An integrated method would assist regional planners to identify which activities would help with regional growth and sustainability. It would also make contradictions between frameworks clear or highlight unrealistic objectives.
- The results of the Integrated Evaluation Model would be beneficial to local authorities in decision-making processes involving projects for development planning.
- Agencies providing support to small-scale farms would be able to identify ways in which both the farm and region would be helped the most.
- The results can also be used as an evaluation of the effectiveness of programmes previously launched to aid farms.
- The Land Use Management System (LUMS) of a municipality is required to take all the objectives of the region's IDP and SDF as well as the province's SDF and all legislation on a national level regarding planning and environmental issues into consideration (Mopani District



Municipality, 2013). A evaluation method already combining all these requirements would make the task of LUMS much easier.

- The NDP 2030 aims to establish a system where the social and environmental consequences of new developments can be determined, also with the aim of sustainable land use. The evaluation method developed in this study could contribute to such a system.
- The various documents studied refer to one another often as indicated in Figure 3.4. The evaluation method would easily be able to assess compliance of a programme to the objectives of another.

Integrated evaluation has many applications, can make valuable contributions to various processes and can overall help achieve strategic visions.

### 3.8 Chapter Conclusion

The objectives of documents and programmes have been analysed and combined to form one all-encompassing evaluation guideline. The developed evaluation method would not only provide information with regards to alignment against the identified documents, but also information on social, environmental and economic impacts. The evaluation method was tailored specifically for small-scale farming.

Section 3.6 explains the research question of how individual activities can be evaluated against broad strategic visions and objectives. Concerning structuring the method to minimise effort to evaluate multiple documents, a process was developed as illustrated in Figure 3.3. This involved analysing, comparing and categorising the information in the identified documents.

Finally a process required to evaluate small-scale farms with the developed model was developed as represented by Step 4 to Step 7 in Figure 3.3. These steps are provided in Figure 3.8 in a more comprehensible format.

There are numerous application possibilities of the Model: from making processes simpler, ensuring alignment towards a common goal and aiding government agencies in providing support efficiently.

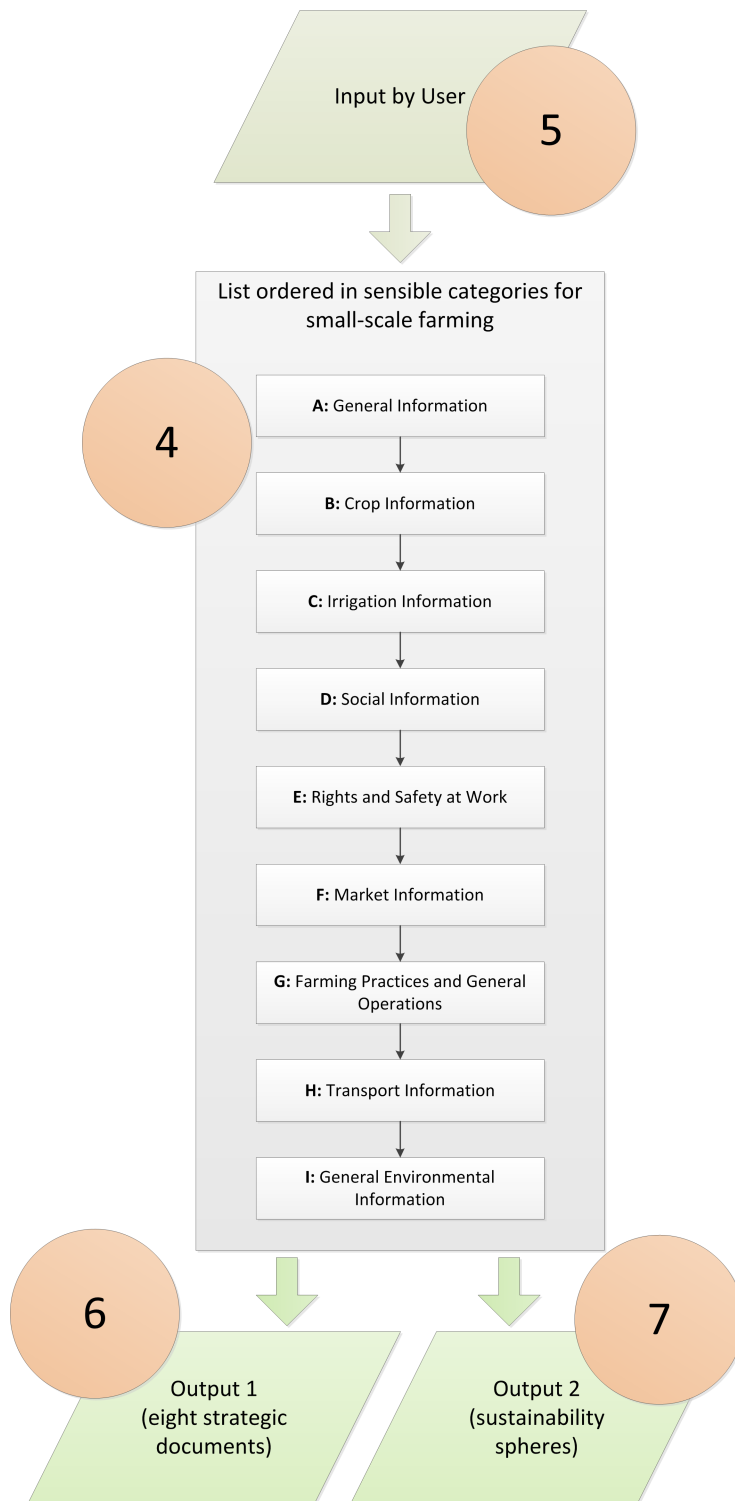


Figure 3.8: Evaluation Process

## Chapter 4

# Letaba Catchment Case Study

The method for evaluating activities as proposed in Chapter 3 is being applied to specific small-scale farms in this chapter. Since the frameworks for the Mopani District Municipality and Luvuvhu/Letaba Water Management Area (WMA) were consulted in the previous chapter, the same area will be used here. An introduction to the area is provided in the following section. Water constraints are one of the most important problems in this region and for this reason the water availability was investigated in more detail than might be necessary in other areas. After the study area is introduced, four small-scale farms in the area are assessed with the guidance of the methods developed in Chapter 3. Sections on the results of the evaluation and environmental, social and economic impacts follow. Thereafter, the water availability of the entire catchment area is investigated under certain scenarios. Using this information, the hydrological impacts of the four study farms are examined. The chapter ends with comments on the success of the evaluation method.

### **Objectives:**

Apply the developed evaluation method to four small-scale farms in the Letaba catchment area. Test whether development as encouraged by strategic planning documents is realistic given the limited water supply in the area.

### **Research questions to be answered:**

1. Can the developed method be applied to real farms and does it provide expected results and useful information?
2. How do area or industry specific constraints compare with the results from alignment with strategic objectives?

## 4.1 Introduction to the Study Area

The Letaba catchment (Figure 4.1) in Limpopo province is an area with many development ideals. It is identified as an important development area in the province for tourism and businesses alike. Agricultural activity, especially small-scale agriculture, is also expected to expand. These developments would be highly advantageous for the social and economic welfare of the area. However, the water supply in the catchment is not reliable with demand already exceeding supply. In 2009 areas in the catchment experienced serious drought conditions and in June that year they were declared as disaster areas (Mopani District Municipality, 2013). The expected future development would put further stress on the already limited water resources.



**Figure 4.1:** Location of Letaba Catchment Area in South Africa

The Letaba catchment is a semi-arid to arid area with highly variable rainfall. The main economic activity in the region is agriculture. Rainfall in the mountainous western part of the catchment averages around 2000 mm annually, while the drier eastern region receives lower rainfall of about 400 mm per year. The significant difference in rainfall by region complicates agricultural activities in the drier areas and demands effective control to ensure that water is distributed fairly. Rainfall is also variable per season. Limpopo province receives 90% of its annual precipitation during the summer months, October to March (M'Marete, 2006).

The western region of the catchment is a mountainous area with successful agricultural activity and large dams, with Tzaneen as the main urban centre. Further east is a low-lying, drier area with a high rural population and emerging commercial and subsistence farmers. The most eastern part of the catchment forms part of the Kruger National Park. The major land use types are illustrated in Figure 4.2.

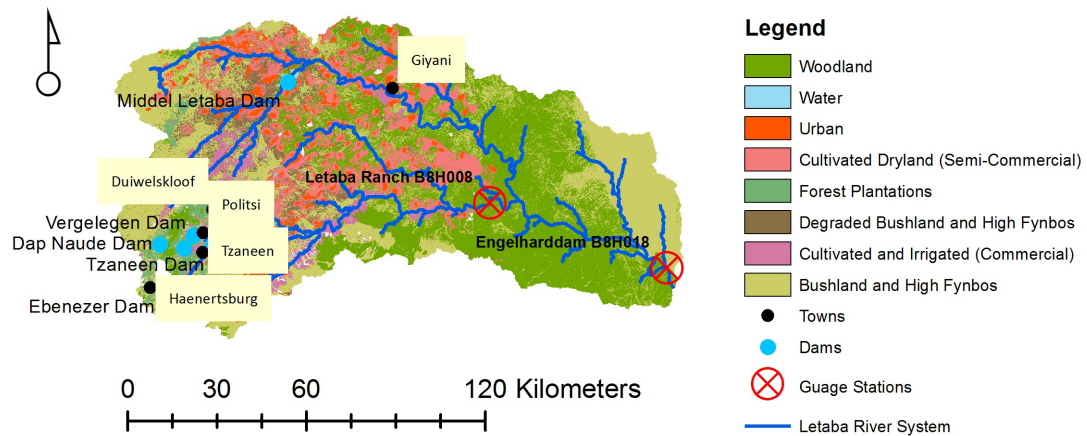


Figure 4.2: Letaba Catchment Area

Water requirements in the catchment are predominantly supplied by surface water. The most important supply schemes are the Middle Letaba Rural Water Supply Scheme, Dap Naude Dam Water Supply Scheme, Ebenezer Dam Water Scheme, Magoebaskloof Dam and Vergelegen Dam Scheme, Tzaneen Dam Scheme and Modjadji Dam. These schemes provide water for the large town of Tzaneen, as well as Duiwelskloof, Haenertsburg, Ga-Kgapane, Politsi, Letsitele, many smaller rural villages and Polokwane, which is located outside of the catchment area (Aurecon, 2010).

For the commercial farms irrigation is mainly supplied by large dams in the upper part of the catchment. More than 70% of water is allocated for irrigation (Katambara and Ndiritu, 2009). Subsistence farms are mainly dependent on rainfall for water requirements. Other small-scale farms abstract water from boreholes or directly from rivers, depending on the location of the farms.

#### 4.1.1 Planned Development in the Letaba Catchment

Water allocation in the Letaba catchment already exceeds the availability (DWAF, 2011). Further developments in the region will aggravate the situation and should thus be carefully considered to ensure that they really make a positive contribution to the area and does not affect the water availability in a harmful way.

Other factors such as climate change will also have an influence on the water in the catchment through increasing temperatures and changing rain patterns. Population growth will reduce the water available for agriculture and economic activities as water for basic human needs receives priority over other water uses

according to the National Water Act (NWA) (De la Harpe, 2006).

To improve the economic and social situation of the rural communities, many subsistence farmers are entering the commercial farming industry. If managed properly, this could improve the economic and social condition of the area, as well as help in securing food security. However, without proper planning and management this could have a negative impact on the water security of the area.

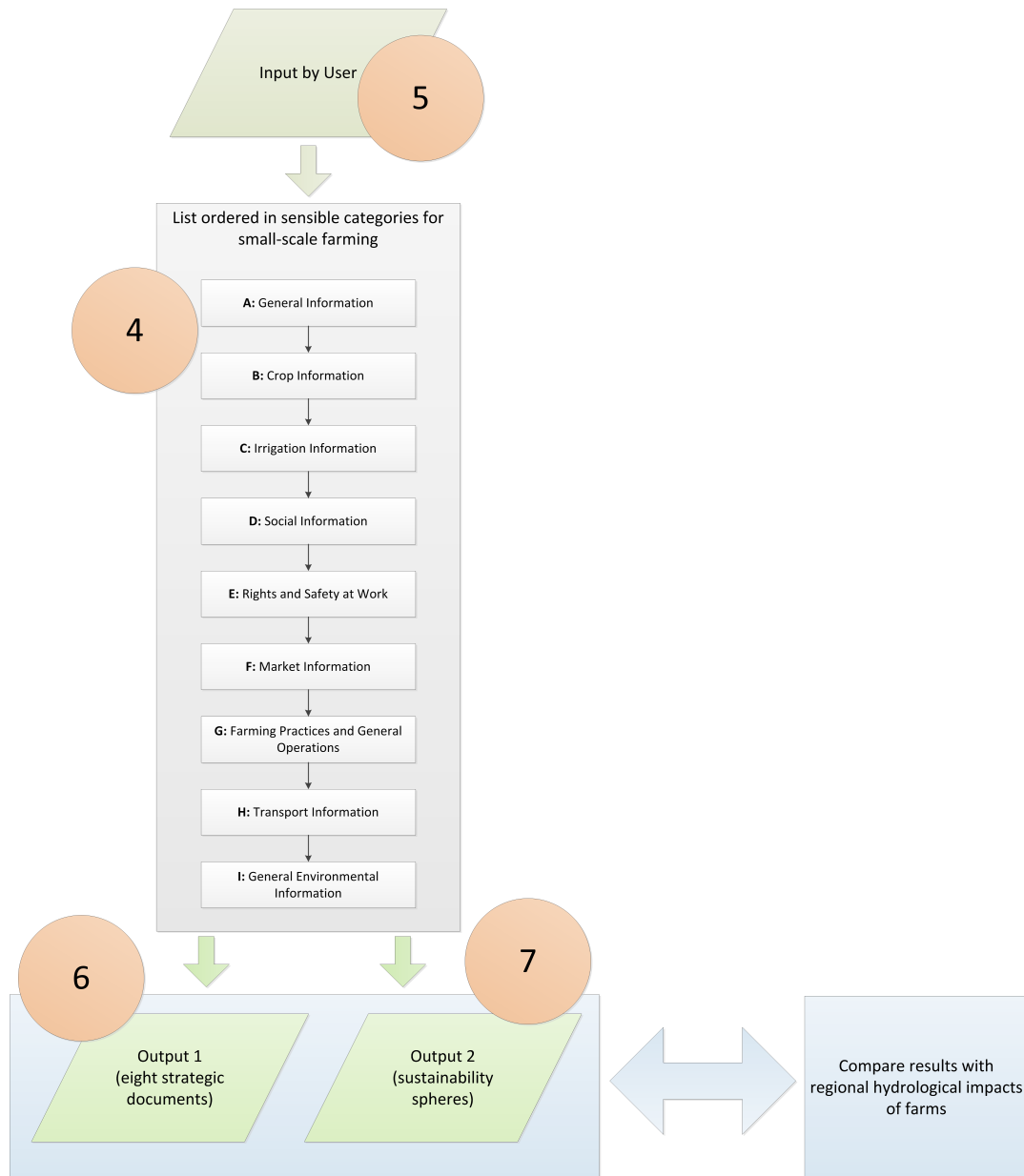
According to M'Marete (2006), 17.1% of the land in the Letaba area is arable in terms of soil suitability and 48.5% is classified as marginal. In Limpopo Province the arable land sums to 2 359 147 ha of which only 181 000 ha is irrigated. This equates to less than 8% of the potential arable land. The most important reason for the arable land not being used for irrigated agriculture is believed to be water scarcity (M'Marete, 2006). Alexander *et al.* (2010) also remarked that agricultural development could have harmful impacts on the environment in the Letaba region and specifically on the Kruger National Park (Alexander *et al.*, 2010).

The Mopani District Municipality was identified as the most important development point in the Limpopo Province for tourism and business attraction due to the diverse range of activities and natural splendour found there. Although agriculture is the main economic activity in the area and is expected to expand, the tourism, mining and trade and manufacturing sectors have all been identified as having growth potential (Aurecon, 2010). “*To be the food basket of Southern Africa*” is included in the Mopani District Municipality’s vision, which signifies a strong support for agricultural development (Mopani District Municipality, 2013). If these sectors develop as planned, even further stress would be put on the catchment’s resources and the competition for water will become more severe.

It can be seen that development in the area is encouraged by various parties and is expected or considered across different industries. On the other hand, many parties are also concerned about limited water supply, since demand already exceeds supply without the added stress from future development options.

## 4.2 Evaluation of Small-Scale Farming

Four small-scale farms have been selected for evaluation with the Integrated Evaluation Model. All of the farms fall within the Greater Giyani Local Municipal area, which forms part of the Mopani District Municipality. Key facts about the four farms are summarised in Table 4.1.



**Figure 4.3:** Process for Evaluating Small-Scale Farms

The evaluation method created in Chapter 3 was summarised in Figure 3.8. Since this study specifically requires more detailed hydrological information, an additional step is added as indicated in Figure 4.3.

The following sections describe the user inputs as explained in Section 3.6.5.

**Table 4.1:** Case Study: General Farm Information

Farm	Location		SWAT Sub-basin	River		Irrigation Source	
	Lat	Long		Great Letaba	Molo- totsi	Surface	Borehole
<b>Zava</b>	-23.640	30.727	47	x		x	
<b>Mzilela</b>	-23.592	30.817	39		x		x
<b>Duvadzi</b>	-23.567	30.820	30		x	x	
<b>Dzumeri</b>	-23.571	30.660	30		x		x

### 4.2.1 General Information

This section serves as an introduction to the farms and simultaneously covers Input A, *General Information*, from Figure 4.3. The spatial significance of the farms is also discussed here.

#### Zava Farm

The Zava village community project (Figure 4.4) is a 13 hectare farm located in Sub-basin 47 of SWAT near the Great Letaba River and quaternary catchment B81F (Figure 4.8).



**Figure 4.4:** Zava Village Community Project. Source: Google Earth

#### Mzilela Farm

The Mzilela Farm (Figure 4.5) is also a village community project. This four hectare farm is located close to the Molototsi River, but too far to abstract directly from it. The location is indicated in Figure 4.8 in Sub-basin 39 of SWAT and quaternary catchment B81H.





**Figure 4.5:** Mzilele Village Community Project. Source: Google Earth

### **Duvadzi Farm**

The 6.5 hectare Duvadzi farm is located next to the Molototsi River (Figure 4.6 and Figure 4.8). Products are sourced to a local and national market. It is located in Sub-basin 31 of SWAT and quaternary catchment B81H.



**Figure 4.6:** Duvadzi Farm. Source: Google Earth

### **Dzumeri Farm**

As seen in Figure 4.7, this farm is located next to a small dam and next to the village of Makhwivirini (located in Sub-basin 31 of SWAT and quaternary catchment B81H). This eight hectare farm supports the households from the village.



Figure 4.7: Dzumeri Farm. Source: Google Earth

### Spatial Evaluation

Figure 4.8 indicates the location of the farms with regards to the catchment and its quaternary catchments. B81F is defined as moderately sensitive and B81H as low or marginally sensitive.

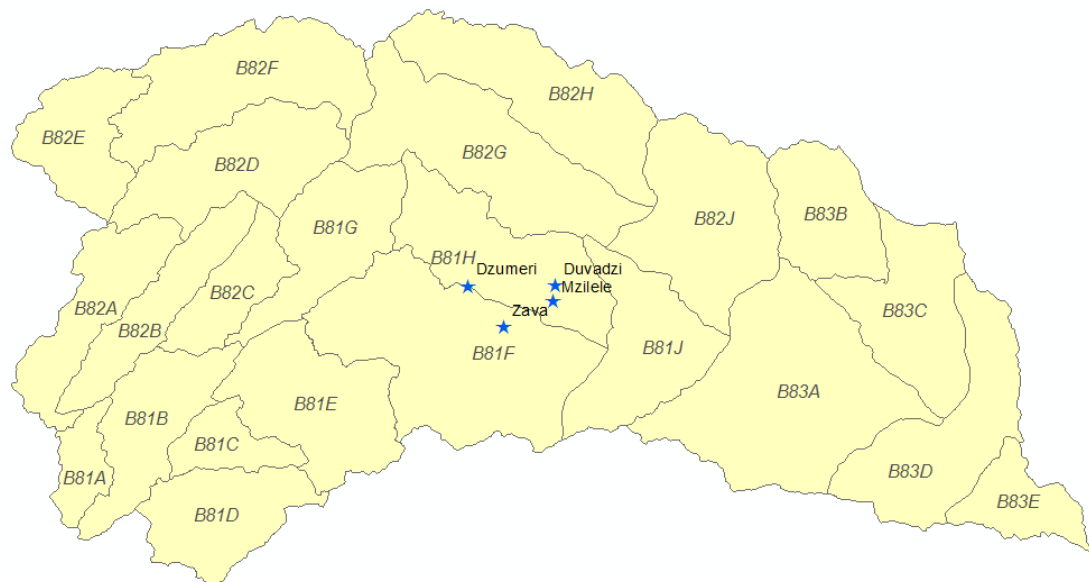


Figure 4.8: Quaternary Catchments in Letaba

Figure 4.9 shows the municipalities of the area. The grey areas represent the Mopani District Municipality. The orange dots (as indicated on Figure 4.10 as well) represent growth points in the Greater Giyani Municipality.

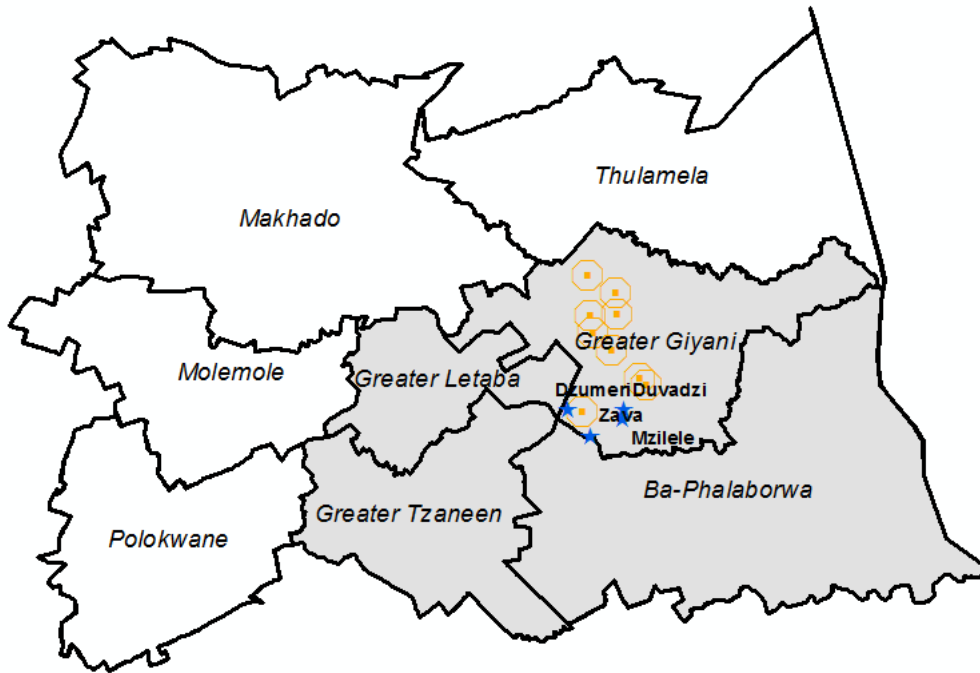


Figure 4.9: Municipalities Surrounding the Study Sites

### 4.2.2 Crop Information

Crop Information is Input B from Figure 4.3. The period from January to December 2011 was used for crop yields.

The crops for this season for the four farms and their corresponding yields are indicated in Table 4.2. Since Duvadzi did not yield crops for the specified season, it did not make a contribution to food security.

### 4.2.3 Irrigation Information

Input C of Figure 4.3 involves irrigation information. Zava, as seen in Figure 4.4, is located adjacent to a river (the Groot Letaba River) and would use this water for irrigation. Both drip and furrow irrigation is used. Mzilele uses drip irrigation from borehole and rainfed sources. Duvadzi makes use of alluvial and rainwater for furrow irrigation, whereas Dzumeri uses borehole water for irrigation.

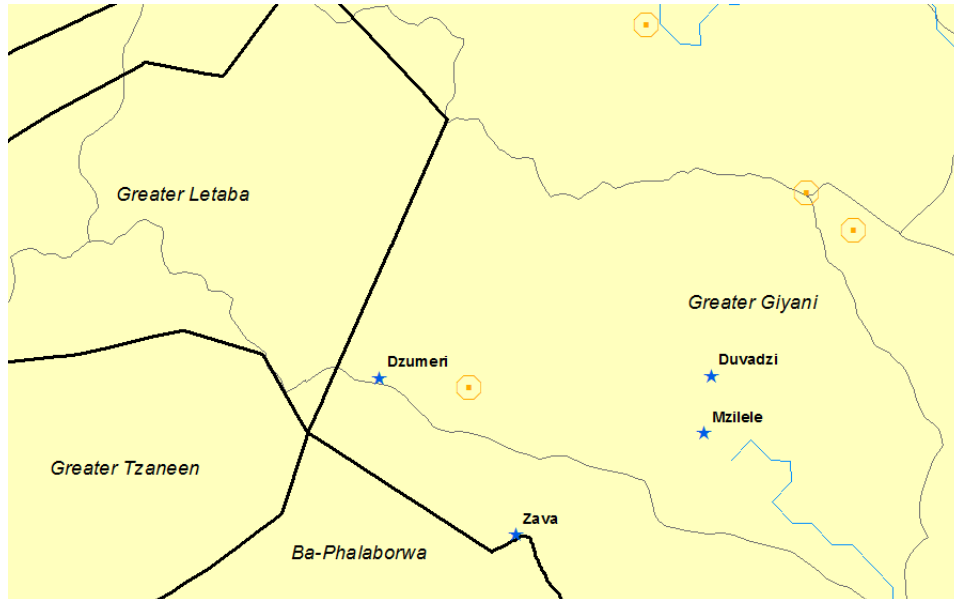


Figure 4.10: Study Sites and Growth Points in Greater Giyani Municipality

Table 4.2: Crops Types and Yields: Jan-Dec 2011

	Crop 1	Crop 2	Crop 3	Crop 4	Crop 5	Crop 6
<b>Zava</b>	Maize 1344 kg	Groundnut 240 kg				
<b>Mzilela</b>	Maize 1765 kg	Pumpkin 0 kg	Tomato 125 kg	Red beet 0 kg	Spinach 48 kg	Okra 136 kg
<b>Duvadzi</b>	Maize 0 kg	Tomato 0 kg				
<b>Dzumeri</b>	Mango 1380 kg	Oranges 300 kg	Tomato 1710 kg	Maize 1000 kg	Chillies 1500 kg	Bean 0 kg

All of the farms are part of the EAU4Food programme which gives them access to water efficient technologies. This project aims to help the farms achieve higher water productivity. The amount of water needed per season was derived from evapotranspiration information from SWAT.

None of the farms use a previously developed irrigation scheme, use recycled water for irrigation or plan to build a new farm dam. Mzilela and Zava have registered their water uses and their WULs are in process.

#### 4.2.4 Social Information

Social Information is provided as Input D in Figure 4.3. All owners and employees of the farms are classified as HDIs. Zava and Mzilela have female

owners. Zava employs 47 people, Mzilela has 17 employees, Dzumeri has 14 and Duvadzi has three.

The farmers receive training from the ARC, NTK and Itireleng NGO and do have access to external knowledge and support. Mzilela's employees have other skills than farming, since they produce traditional cloths and necklaces as well as cellphone pouches.

As mentioned they are all part of a programme for the productive use of water through EAU4Food. Zava and Mzilela are both part of community co-operations/projects, but none of the farms are part of Water User Associations.

#### 4.2.5 Rights and Safety at Work

All the farms provide the same rights to their workers and the employees are exposed to the same dangers. This information is under Input E of Figure 4.3.

#### 4.2.6 Market Information

Input F encompassed all information about markets and products of the farms. The farms supply their products directly to households as well as local markets (the market as well as the local Spar and Pick 'n Pay). Mzilela supplies chillies to Johannesburg. Dzumeri and Duvadzi also supply to national markets (although Duvadzi did not yield crops for the specified growing season).

The farms supply to and buy products from people of different race, religion or language than themselves. They buy the majority of their products from their local municipal area, in Giyani.

Mzilela and Zava use natural resources as part of economic activities by selling maize residues and grass to cattle farmers during drought periods. Mzilela also uses indigenous Mopani trees for trellising. However, none of the farms provide any new or uncommon products to the region. None of the farmers are in any way involved in agro-processing activities.

#### 4.2.7 Farming Practices and General Operations

Input G of Figure 4.3 deals with *Farming Practices and General Information*. Pesticides are used by all the farms, but only some of the farms (Zava and Dzumeri) use fertilizers. These fertilizers are from cattle manure and can be seen as a recycling initiative. Mixed cropping is implemented by Zava and Dzumeri.

### 4.2.8 Transport Information

Transport Information is provided in Input H of Figure 4.3. All of the employees on the farms live within walking distance from the farms and consequently do not have a negative effect on the environment in terms of transport. Produce is however transported to markets by trucks and are all located far (more than 30km) from the farms.

### 4.2.9 General Environmental Information

Input I of Figure 4.3 is the final information required by the user and deals with general environmental impacts. The farms make use of soil-erosion control measures. All of the farms except Duvadzi are part of a road network. However, only Dzumeri is located close to an identified municipal growth point. The farms undertake burning activities which have harmful effects on the quality of the air.

## 4.3 Results of Evaluation Model

This section discusses the output of the evaluation model which is indicated by Step 6 (Output 1) and Step 7 (Output 2) of Figures 3.3 and 4.3. All the information as discussed in the previous section was added to the input interface as represented by Step 4 in Figure 4.3. The input and output interfaces can be seen in Appendix A. The results obtained from the inputs are discussed below.

### 4.3.1 Output 1

Output 1 represents the results scored for alignment with strategic documents. This output can be seen in Figure 4.3 as Step 6.

The scores for contribution to each strategic document are divided into classes and colour-coded for easier comparison and assessment (as illustrated in Figure 4.11). The scores in the Excel Interface (Appendix A) are also colour-coded for the same reason. Scores are measured in percentages. The output score measures the farm against the ultimate possible contribution it can make to help reach the goals of any of the documents. A bad score does not reflect that the farm is opposing the vision of the region, but simply indicates room for improvement and furthermore gives feedback on where such improvements can be made. Accordingly, 100% indicates the maximum contribution a farm can make to a specific plan.

Regarding individual farms, Zava is most aligned with achieving regional objectives. Four out of eight scores are above 80% and there are no scores in the

	STRATEGIC PLANNING DOCUMENTS							
	NDP 2030	NFSD	ISRDS	IDP	SDF	LED	CMS	WAR
Zava	62	64	86	83	63	63	91	100
Mzilela	62	57	86	72	63	38	73	88
Duvadzi	46	57	71	50	38	25	82	88
Dzumeri	54	57	71	61	50	50	91	100

Figure 4.11: Results for Output 1 (Strategic Documents Evaluation)

bottom two categories. The biggest difference are higher scores against the IDP, LED and NFSD. Duvadzi performed the worst overall with two scores under 40%. Zava scored higher against every document than Duvadzi, except against the NDP 2030 where they both scored 62%. Comparing these two farms, some of the factors contributing to the results are the higher productivity achieved by Zava, the number of employees and female owner of Zava, being part of a community association and being included in a road network.

### 4.3.2 Output 2: Social Evaluation

Step 7 of Figure 4.3 represents the results regarding the three sustainability spheres. The social impacts and contributions will be discussed here.

The farms scored the same for many social criteria, since all the small-scale farmers in the catchment satisfies the criteria of having a HDI owner, providing access to land and resources to rural poor and have the same approach of rights guaranteed at the workplace and safety at work. They are all also part of programmes for the efficient use of water and receiving training. Most of the farmers do not have any skills other than farming.

STRATEGIC PLANNING DOCUMENTS								
	NDP 2030	NFSD	ISRDS	IDP	SDF	LED	CMS	WAR
Zava	62	64	86	83	63	63	91	100
Mzilela	62	57	86	72	63	38	73	88
Duvadzi	46	57	71	50	38	25	82	88
Dzumeri	54	57	71	61	50	50	91	100

Figure 4.12: Results for Output 2 (Sustainability Evaluation)

Zava provided much more jobs per hectare than any of the other farms. Since this farm is furthermore owned by a female HDI it scored very high in terms of providing opportunities for the rural population.

Differences occurred with the contribution to food security. Although all the farms contribute by supplying directly to households and all of the farms also produce food with nutritious value, productivity is another factor considered when evaluating food security. If all factors are considered it can be said that Zava contributed most to food security in the specified season and Dzumeri contributed the least.

Zava and Mzilela are both community projects and would consequently contribute to the objective of *“Participation of Community”*.

### 4.3.3 Output 2: Environmental Evaluation

The environmental impacts as included in Step 7 of Figure 4.3 are evaluated here.

It is assumed for the case of small-scale farming that all the farms are located on land allocated to agriculture according to a SDF. Since SDFs are based on



principles of using land to its full potential, it is assumed that by using it for small-scale farming it is fulfilling that goal.

Again, most of the environmental criteria would be similar for the four farms. Differences occur at the proximity to towns, local growth points and a road network. Since all the farms supply to at least the local market, not being part of a road network, such as Duvadzi, can be harmful to the environment. Dzumeri being located at an identified growth point would have the least impact on the environment in terms of spatial planning and transport.

Zava scored the highest for “*General Water Score*”, because of water productivity for the specific season as well as the higher streamflow of Sub-basin 49 compared to the other locations.

Some of the farms (Zava and Dzumeri) use manure from cattle as fertilizer, which is positive as a recycling initiative.

#### 4.3.4 Output 2: Economic Evaluation

The final output to consider is the economic aspect of Step 7 in Figure 4.3.

All four farms make a contribution to the local economy by being involved in the local supply chain. Supplies are obtained from the local municipal area and produce sold at the local market. There is however room for improvement in terms of involvement in the agro-processing industry. Agro-processing offers many opportunities for socio-economic growth, either through on-farm agro-processing or supplying to local agro-processors. Duvadzi and Dzumeri supply to the national market in addition to the local market, linking the area to external markets and opportunities.

Some of the farms (Dzumeri and Zava) make use of mixed-cropping systems, which is regarded as a farming practice to increase productivity. Mzilela farm uses local natural resources, Mopani trees, for trellising. Although income is not directly incurred through the use of this resource, expenses are saved.

As explained in Chapter 3, different crops have different employment potential. Zava, cultivating maize and groundnuts, shows the lowest employment potential. None of the farms contribute to the diversity of industries (or products) for resilience as the typical economic activities within the municipality are small-scale farming (with maize, tomatoes, other vegetables and beef), retail, services and transport (Maake, 2010).

Within the Greater Giyani Municipality, Giyani town is the main urban centre with the most employment, retail and recreational opportunities. All the

farms are located more than 30km from this growth point, however, Duvadzi is identified as one of the additional smaller growth points.

### 4.3.5 Observed Trends in Results

All the farms fare well (as expected) against WAR, since this programme is aimed at equity in providing water. Results against the LED and SDF differ greatly, whereas performance against other documents is comparable. Compliance with NFSD is relatively low for all farms. This result is ascribed to the basic nature of small-scale farming and the NFSD's objectives of new and innovative ways to strive towards sustainability.

It is interesting that performance against the CMS is high even though the CMS directly mention scarcity of water and the prohibition of additional surface water for irrigation and building of farm dams. The farms seem to comply with the values of the CMS, despite the discouragement of additional agriculture.

The results against sustainability criteria also show certain trends. Looking at the results, it can immediately be seen that scores against social are the best, environmental scores are mixed and economic scores are bad. These results would be expected from small-scale farms, as small-scale farming is known to have many opportunities for social growth. Environmental impacts are mixed, since impacts are of a small scale, but not much is done to support sustainability of the environment. Although the farms contribute to the local economy there is still much room for improvement.

Sections where the scores of all four farms are very close it can be said that the results are expected from small-scale farms in general and expansion of small-scale farms would make similar contributions. However, in cases where the results differ significantly, such as LED in Output 1 and "*Opportunities*" and "*General Water Score*" in Output 2, it indicates that farms have the potential to improve and make a better contribution. The effect of small-scale farming on these scores would be more difficult (or not possible) to predict.

### 4.3.6 Validation

In order to validate the development of the Integrated Evaluation Model for small-scale farms it is necessary to determine whether it has theoretical value and can be applied to actual cases.

The developed tool was implemented by applying it to four small-scale farms in the Letaba catchment. These farms form part of the EAU4Food project. Information was supplied by persons with experience on the specific farms (one

person performed research on Mzilela farm in particular as part of EAU4Food, the other is an extension officer in the Giyani region for the Department of Agriculture).

All input information was applicable to all the farms. Results showed certain logical trends, but differed for each farm.

## 4.4 Determining the Water Available for Development

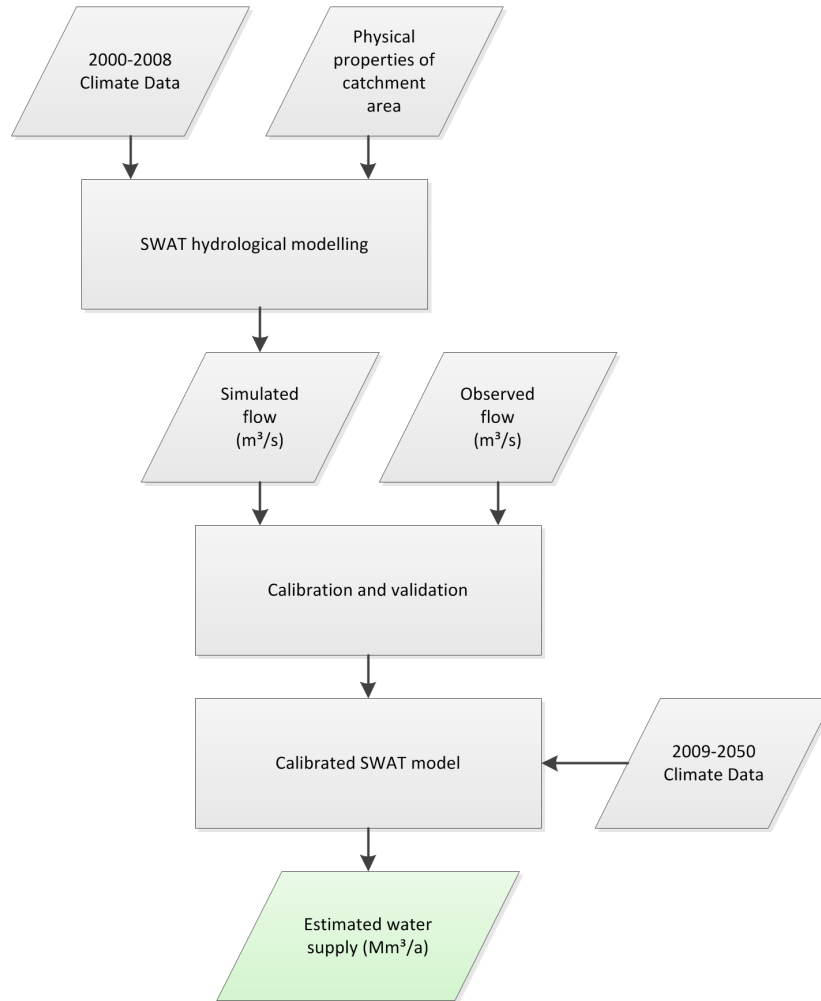
Section 4.1 and Figure 4.3 indicated the need for further hydrological investigation to evaluate the proposed results of Section 4.3. However, the water situation in the entire catchment needs to be investigated first. The following section would focus on the hydrology of the farms. As mentioned, the expected future development would put further stress on the already limited water resources. Climate change, population growth and obligations to the downstream Kruger National Park are all considerations to be taken into account when examining future water availability in the region and the allocation thereof.

The future of water supply was investigated through combining the outputs of a hydrological model based on the Soil and Water Assessment Tool (SWAT), climate change data and population growth estimations. The aim of this investigation is to determine the water supply available for development in the Letaba catchment with the effects of climate change and population growth taken into account. This information should be used to plan development in the area. The period up to 2050 is studied. The average annual water availability was examined; therefore seasonal variability in water availability is not included in this exercise.

### 4.4.1 Methodology

The water available for development was estimated by following the methodology as illustrated in Figure 4.13 and Figure 4.14. The first phase is hydrological modelling based on the Soil and Water Assessment Tool (SWAT) followed by the second step of scenario analysis involving population growth estimates.

SWAT was used to perform the hydrological modelling and includes climate change projections and present day conditions of the catchment area. The scenario analysis involves population growth estimates. Increased water use from population growth and improved service levels as well as water required for the ecological reserve is subtracted from the future water availability calculated with SWAT. The difference between the modelled water availability and

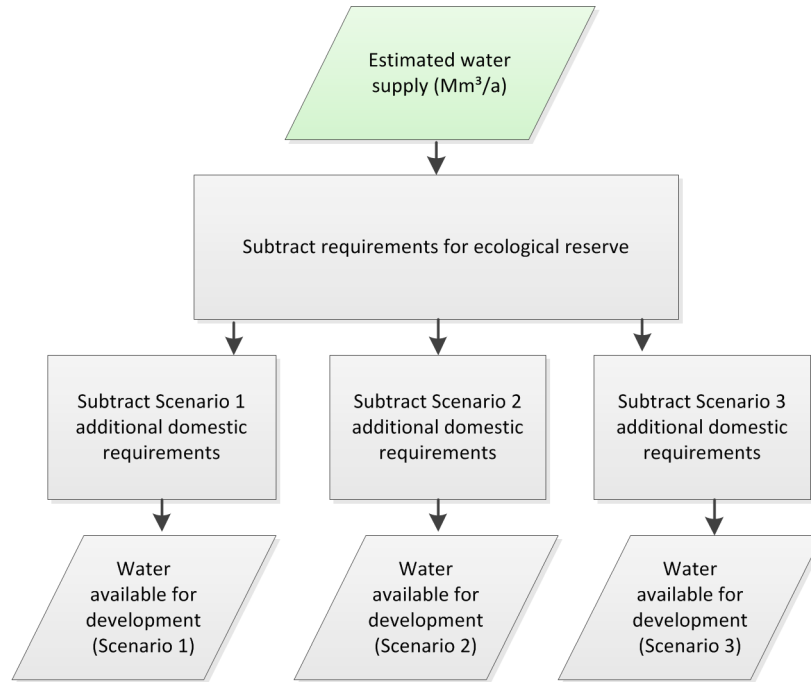


**Figure 4.13:** Step 1: The Hydrological Model

additional primary requirements would indicate the amount of water available in the system for any additional water use activities. Present day agricultural activities are already incorporated in the model, thus in the case of a deficit, it would signify agricultural water supply should decrease since domestic water use receives priority over agricultural use.

### Step 1: The Hydrologic Model

The SWAT model was developed by the United States Department of Agriculture (USDA) to estimate the impact management actions will have on the water, sediment and chemical yields in catchment areas. The model is a continuous time-step model that can be applied over extended time periods and on large complicated catchments (Gassman *et al.*, 2007). SWAT divides a catchment area into sub-basins, which are further divided into Hydrological Response Units (HRU). An HRU is a region with the same land cover, soil



**Figure 4.14:** Step 2: Scenario Analysis

and slope profile. The flows for each HRU are summed to sub-basin level.

SWAT is increasingly applied globally to predict effects of climate change and anthropogenic influences on water resources and to eventually determine appropriate measures to minimise harmful effects. SWAT is also used to assess the benefits of conservation practices and with total maximum daily loads (TMDL) analysis (Gassman *et al.*, 2007). This study focused on the hydrological processes of SWAT.

#### *SWAT Model Inputs*

The most important data inputs for the SWAT model and their corresponding sources are listed in Table 4.3. Table 4.4 describes the land cover distribution of the catchment as used by the SWAT model. Only land covers comprising more than 20% of an HRU is included in the SWAT model. More information on the building of the SWAT model can be found in Appendix B.

Climate change was incorporated into the model by using data provided by the Council for Scientific and Industrial Research (CSIR) as the climate input to the SWAT model. The forecasted climate change data is available on a 50 km<sup>2</sup> scale and includes values for precipitation, temperature, solar radiation, relative humidity and wind speed. For this region the data has been based on average temperature increases of about 0.04 °C annually and changes in rainfall patterns over the long term.

**Table 4.3:** SWAT Model Input Data

Data Input	Source
Soils	SOTER for Southern Africa (SOTERSA)
Land cover	National Land-Cover (NLC) 2000
Digital Elevation Model	Shuttle Radar Topography Mission 90 m (SRTM 90 m)
Climate	CSIR

**Table 4.4:** Land Cover Distribution in SWAT Model

Land cover converted from NLC2000	Area in model ( %)
Woodland	38
Bushland and High Fynbos	31
Forest Plantations	4
Degraded Bushland and High Fynbos	3
Cultivated Dryland (Semi-Commercial)	18
Cultivated and Irrigated (Commercial)	5
Water; Cultivated Dryland (Commercial); Cultivated and Irrigated (Semi-Commercial); Bare Soil; Urban/Built-Up; Grassland	<0

#### *Model Calibration*

The model was calibrated against average monthly observed streamflow data at various gauge stations in the catchment. The data for these stations is obtainable from the Hydrological Services website of DWA.

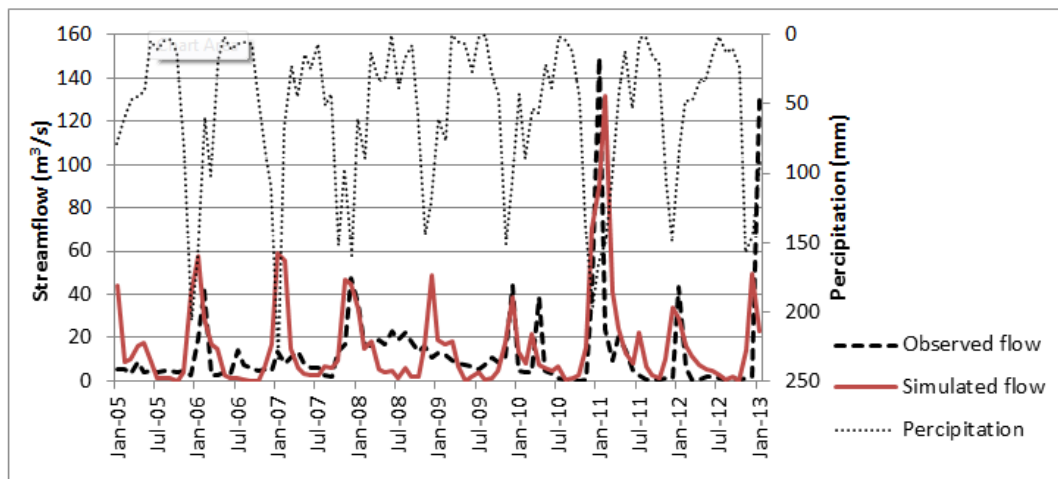
The streamflow from 1999 to 2005 was used as a calibration period and 2006-2012 as validation, according to the split-sample test (Klemeš, 1986). The Nash-Sutcliffe efficiency (NSE), a model evaluation statistic, was used to test the simulated streamflow against observed streamflow at Letaba Ranch gauging station (B8H008) and at the catchment outlet at Engelhard Dam (B8H018). The locations of the gauge stations can be seen in Figure 4.1.

An NSE value between zero and one is generally acceptable and a value above 0.5 is good (Moriasi *et al.*, 2007). A result of 0.43 was obtained for monthly values calibration and 0.05 for the validation period. The percent bias (PBIAS) evaluation statistic was also applied. The optimal value is zero, whereas a high value indicates underestimation and a low value, overestimation. A value between -25 and +25 is satisfactory. A PBIAS rating of 20.2 was achieved for

calibrated streamflow and -20.8 for validation. Figure 4.15 shows the observed and simulated streamflow at Engelhard Dam for the validation period. The overestimation should be taken into account when interpreting the model results.

An explanation for the overestimation of the model might be the climate data. Climate data is one of the most important inputs in a hydrological model. Not using observed data have an effect on the accuracy of a model. Another shortcoming of the model which might be a reason for inaccuracy is water use data. Reservoirs and borehole abstractions were the same for every year in the simulation and farm dams were not incorporated. For the purpose of this study, the model is sufficient, since only the annual volume and trends of water will be examined.

Further information on the validation and set up of the SWAT model can be found in Appendix B. Amongst others, information on input data, irrigation and evapotranspiration is provided.

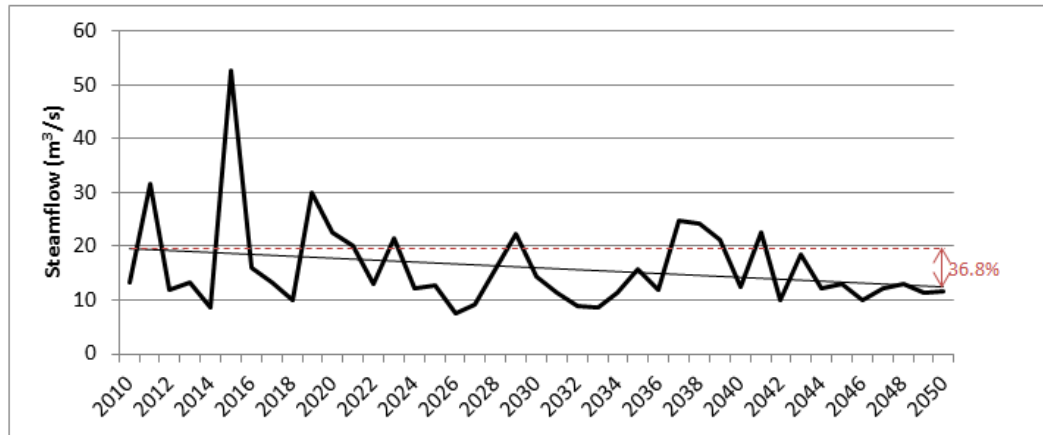


**Figure 4.15:** Streamflow at Engelhard: Validation Period

## Step 2: Scenario Analysis

### *Population Growth*

Three population growth scenarios were developed representing different growth rates and trends. Estimated populations for the various municipalities in the catchment are recorded in Table 4.5. The urban population of Ba-Phalaborwa municipality was excluded as they do not rely on the Letaba River system for water supply. Of the rural population, only one third uses water from the



**Figure 4.16:** Average Annual Forecasted Streamflow at Engelhard

Letaba River system therefore the rest of the rural population was excluded.

Scenario 1 is based on global population estimations made by the Department of Economic and Social Affairs of the United Nations (Department of Economic and Social Affairs, 2011). From the UN estimations, long term trends in the South African population could be seen. The South African population is estimated to grow on average at a rate of 0.29% per year from 2013 to 2050. However, this rate is decreasing annually and a turnaround point is reached by the year 2063 when it is believed that the population will start to decline. This information is used in conjunction with local data to make it relevant to the study area.

Statistics South Africa has data available on Limpopo province's share of the South African population for a number of years from which a decreasing trend can be seen. This negative rate was applied to make predictions up to 2050.

Scenario 2 is based on population growth trends as found in the 2007 Municipal Survey conducted by Statistics South Africa (Statistics South Africa, 2008). A constant growth rate was assumed. The growth trends for the different local municipalities within Mopani District Municipality vary greatly. The Greater Letaba Local Municipality's population grew by more than 12% from 2001 to 2007 whereas the number of residents in the Greater Tzaneen Local Municipality decreased by about 7% during that period (Statistics South Africa, 2008). This information was taken into account in the forecasting of domestic water requirements. The number of people per household decreased from an average of 4.4 persons per household in 2001 to about 4 in 2007. This trend can have an impact on water consumption.



A further interesting trend in the area is an increase in rural population and decrease in urban, which is contrary to the trend of the rest of the province and country. The reason is assumed to be related to the urban population entering the agricultural sector as the region is very dependent on agriculture (Aurecon, 2010).

Scenario 3 is a positive growth scenario. A baseline growth rate of 2.52% was used increasing every year. This estimation is based on literature from other similar studies (Aurecon, 2010).

#### *Domestic Water Requirements*

In 2010 22 Mm<sup>3</sup> was used for domestic use in the Letaba catchment. At that time 25% of the region's population received less than the basic water supply of 9.125 m<sup>3</sup>/year. By 2015 the municipality aims to improve the figure of basic supply of water to 85% of the population (Greater Letaba Municipality, 2013).

To calculate the future domestic water requirements it was assumed that the 25% receive less than 9 m<sup>3</sup>/person/year. For a population of 956 615 the remaining 75% would then receive more than 27.7 m<sup>3</sup>/person/year. By 2015 85% of the population would have access to basic water supply and by 2025 the entire region's population. Furthermore, it was assumed that after a person reaches a supply of 9.125 m<sup>3</sup>/year their water consumption will still continue to increase until a quantity of 1.5 times the basic supply is reached. Figure 4.17 shows the resulting water requirements for each scenario.

The Letaba River system supplies Polokwane of 18.75 Mm<sup>3</sup> water per year (12 Mm<sup>3</sup>/year from Ebenezer dam, 6.52 Mm<sup>3</sup>/year from Dap Naude dam and 0.2 Mm<sup>3</sup>/year from Thabina dam). These transfers will also increase with population growth. The same method used in calculating future water requirement for the Letaba catchment was used to estimate the transfers to Polokwane.

Domestic water requirements and transfers to Polokwane are estimated to increase by between 7% for Scenario 1 and 30% for Scenario 2 over the next 37 years. Table 4.6 summarises the available water before and after the ecological reserve, additional domestic requirements and transfers to Polokwane has been subtracted.

### **4.4.2 Results**

As seen in Figure 4.18 the baseline water supply with present day subtractions is variable over years, but does show a negative average trend. The water available for development decreases significantly, but at a different rate each year. For the entire period the decrease in water supply is estimated to be about

Table 4.5: Population Estimates by Area

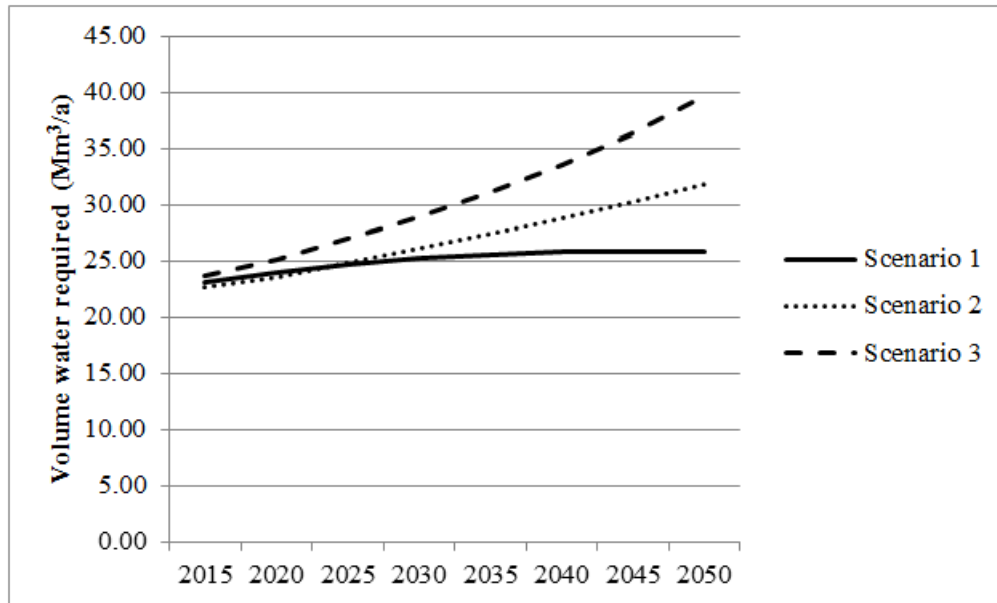
Scenario 1		2015	2020	2025	2030	2035	2040	2045	2050
Giyani	257321	263587	268201	271676	274121	275581	276250	276378	276378
Letaba	257404	263672	268288	271764	274210	275670	276339	276467	276467
Tzaneen	362691	371523	378027	382924	386371	388428	389371	389551	389551
Phalaborwa	15952	16340	16626	16842	16993	17084	17125	17133	17133
Maruleng	99503	101926	103710	105054	105999	106564	106822	106872	106872
<b>Total</b>	<b>992872</b>	<b>1017049</b>	<b>1034852</b>	<b>1048260</b>	<b>1057695</b>	<b>1063327</b>	<b>1065908</b>	<b>1066402</b>	<b>1066402</b>
Scenario 2		2015	2020	2025	2030	2035	2040	2045	2050
Giyani	259283	266819	274574	282554	290767	299218	307915	316865	316865
Letaba	290066	320113	353273	389868	430254	474823	524009	578291	578291
Tzaneen	316636	297907	280286	263708	248110	233434	219627	206636	206636
Phalaborwa	14765	14409	14062	13723	13392	13069	12754	12447	12447
Maruleng	97662	98865	100082	101314	102561	103824	105102	106396	106396
<b>Total</b>	<b>978411</b>	<b>998113</b>	<b>1022277</b>	<b>1051167</b>	<b>1085084</b>	<b>1124368</b>	<b>1169407</b>	<b>1220634</b>	<b>1220634</b>
Scenario 3		2015	2020	2025	2030	2035	2040	2045	2050
Giyani	261601	271784	283486	296867	312113	329444	349115	371426	371426
Letaba	292624	325987	364579	409336	461387	522091	593090	676376	676376
Tzaneen	319519	303552	289551	277313	266665	257462	249579	242912	242912
Phalaborwa	14899	14680	14523	14426	14386	14404	14480	14615	14615
Maruleng	98539	100711	103341	106463	110116	114347	119214	124781	124781
<b>Total</b>	<b>987181</b>	<b>1016715</b>	<b>1055481</b>	<b>1104404</b>	<b>1164667</b>	<b>1237747</b>	<b>1325477</b>	<b>1430110</b>	<b>1430110</b>

**Table 4.6:** Summary of Water Availability and Projected Water Consumptions

Mm <sup>3</sup> /a available*	Water allocation for reserve and additional future requirement for domestic use and velopment transfers to Polokwane						
	EWR** (Mm <sup>3</sup> /a)	Scen1 (Mm <sup>3</sup> /a)	Scen2 (Mm <sup>3</sup> /a)	Scen3 (Mm <sup>3</sup> /a)	Scen1 (Mm <sup>3</sup> /a)	Scen2 (Mm <sup>3</sup> /a)	Scen3 (Mm <sup>3</sup> /a)
2015	566.79	99.31	3.38	3.36	3.98	464	463
2020	586.43	102.76	5.99	6.29	7.38	478	476
2025	412.71	72.32	9.34	9	11.35	331	329
2030	456.57	80	12.88	11.82	15.84	364	361
2035	427.65	74.93	16.61	14.68	20.9	336	332
2040	509.57	89.29	20.56	17.52	26.66	400	394
2045	397.46	69.64	24.83	20.43	33.33	303	294
2050	386.63	67.75	29.49	23.55	41.1	289	278
<b>Average</b>		<b>82</b>					

\*This is the water availability as calculated with SWAT at Engelhard Dam. The value already includes abstractions for all current water uses, thus only increases in water use from 2010 onwards needs to be taken into account.

\*\*The prescribed Ecological Water Reserve (EWR) at Letaba ranch is an average annual value of 82 Mm<sup>3</sup> (Aurecon, 2010). This value can be more or less than 82 Mm<sup>3</sup> according to the rainfall of the specific year. Values for EWR have been calculated accordingly.



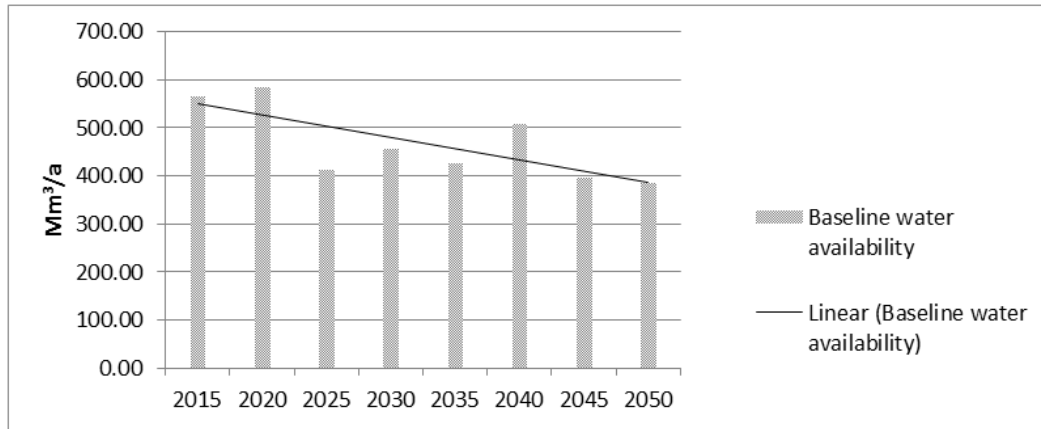
**Figure 4.17:** Projected Domestic Water Requirements for the Letaba Catchment

30%. The fast decreasing trend over the next ten years should be considered in all immediate development plans in the area. The diminishing supply in this period can lead to shortages by 2025 if ignored.

After the environmental reserve and additional domestic requirements are subtracted from the baseline water availability, the remaining volume would be available for development. This volume is expected to decrease by approximately 40% by 2050. It is important to note that these values were estimated using an optimistic model and can be seen as a best case scenario. It is more important to observe the decreasing trend rather than the quantity of water available.

Hydrological modelling incorporating climate change estimations and population forecasts were used to determine future water supply for development in the Letaba catchment. Both climate change and population growth are shown to have significant impacts on the water availability. The effect of climate change alone can decrease water in the river system by 36.8% by the year 2050 (see Figure 4.16), while water for domestic requirements can increase by up to 30%.

The estimated water available for development decreases each year at varying rates according to different population growth estimations. The rate at which the population grows will have a significant impact on the water supply and will be a limiting factor for the degree of development that can be undertaken.



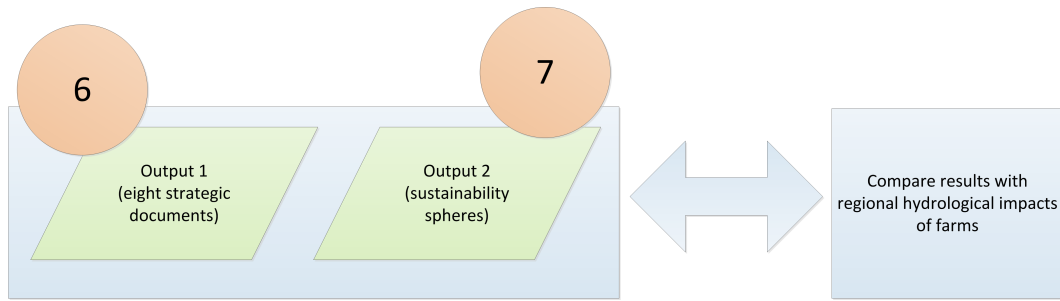
**Figure 4.18:** Water Available Before Domestic and Environmental Reserves are Subtracted

Any plans for development should take the long term supply of water into account as it will have a big impact on the specific development and other activities in the area. Since various development strategies in terms of water consumption are available, the chosen strategy would depend on short term or long term priorities and the life span of the development project. Development that does not consider the trend of future water supply can cause serious problems in the catchment over the long term as certain consumptive uses will need to be discontinued or decreased significantly. Development needs to be controlled and planned on a catchment level to ensure that future demand is met.

The state of water of the entire catchment was investigated to get a general idea what the implications of water might be for development. However, spatial differences will also occur and will therefore be investigated in the next section. Water availability at the specific sites will be modelled (in Section 4.5) to measure the difference in different parts of the catchment and also to determine the impact climate change will have at different locations.

## 4.5 Hydrological Impacts of Results

The impact of the different types of irrigation sources and locations of the farms are modeled in SWAT to see whether location and water source should be considered as an important part of decision-making. This task is performed to evaluate the results obtained in Section 4.3 against hydrological impacts of the farms, as indicated in Figure 4.19. It also serves to determine whether the programs of encouraging small-scale farms as seen by various strategies are advisable from an environmental view point.



**Figure 4.19:** Evaluation of Results

The individual farms are too small to be modelled in SWAT, but since they are of comparable size, larger areas in each sub-basin were modelled. The effect of these larger areas being irrigated would show the impact on the water availability that the encouragement of expansion of small-scale farming would have.

In the event of effects being almost the same, compliance with strategic planning documents can be used to guide expansion of small-scale farming. However, if impacts differ largely the location and water source need to be assessed before looking at strategic planning documents.

#### 4.5.1 Irrigation in Great Letaba River Area or Molototsi River Area

To compare irrigation from Great Letaba River or Molototsi River, the impacts on downstream flow at the catchment outflow was measured for the regions of Zava and Duvadzi farms. The entire HRU of comparable size (26.1 km<sup>2</sup> and 27.4 km<sup>2</sup>) was put under irrigation to test the effect of small-scale expansion. Irrigation from surface flow was compared in both instances under similar cropping systems and comparable surface areas. It was found that the streamflow is impacted most in the sub-basin of the site, with a diminishing effect on sub-basins as the distance downstream increases.

Expansion in the region of Zava (Great Letaba River) causes an average of about 1.3% decrease in streamflow at downstream Engelhard Dam. Whereas the same expansion in the region of Duvadzi had a negative impact of about 0.5% at Engelhard Dam. The difference in streamflow (in m<sup>3</sup>/s) is illustrated in Figure 4.20.

Precipitation in these two areas is the same.

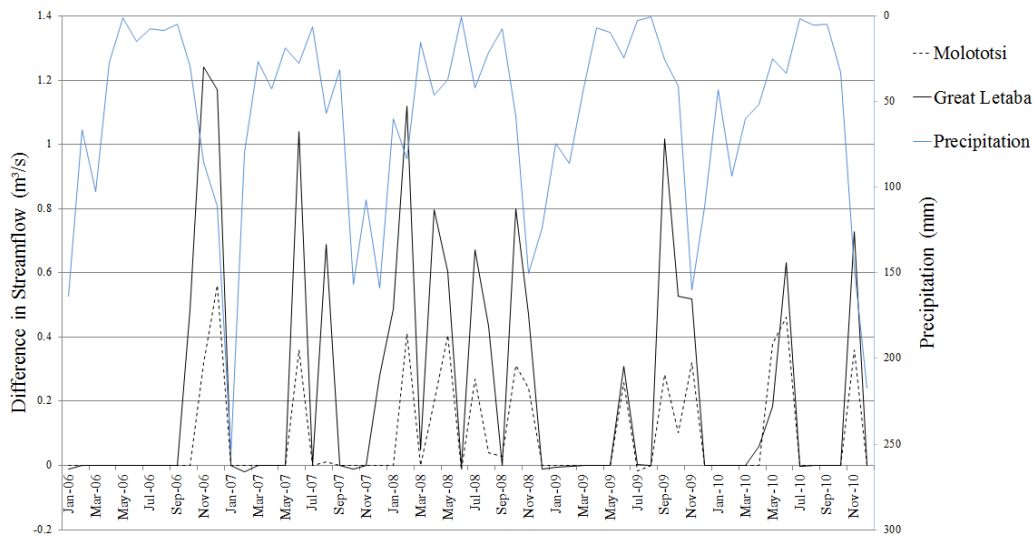


Figure 4.20: Streamflow Reduction from Irrigation (Great Letaba and Molototsi)

#### 4.5.2 Irrigation from Surface Water or Groundwater

Since some farms use surface water as an irrigation source and others use groundwater the difference was investigated with SWAT. The same area near the Molototsi River was modelled with irrigation from surface water and groundwater respectively. The groundwater simulation would represent the expansion of farms comparable to Dzumeri and the surface water represents Duvadzi.

Simulation by SWAT shows irrigation from groundwater near the Dzumeri farm to have almost no effect on streamflow at the Engelhard Dam. This can be ascribed to groundwater recharge and irrigation return flows. It would also explain why additional surface water irrigation is discouraged by the CMS. Groundwater in the Molototsi catchment is estimated to be 12 Mm<sup>3</sup> (DWAF, 2004).

#### 4.5.3 Difference in Precipitation and Evapotranspiration

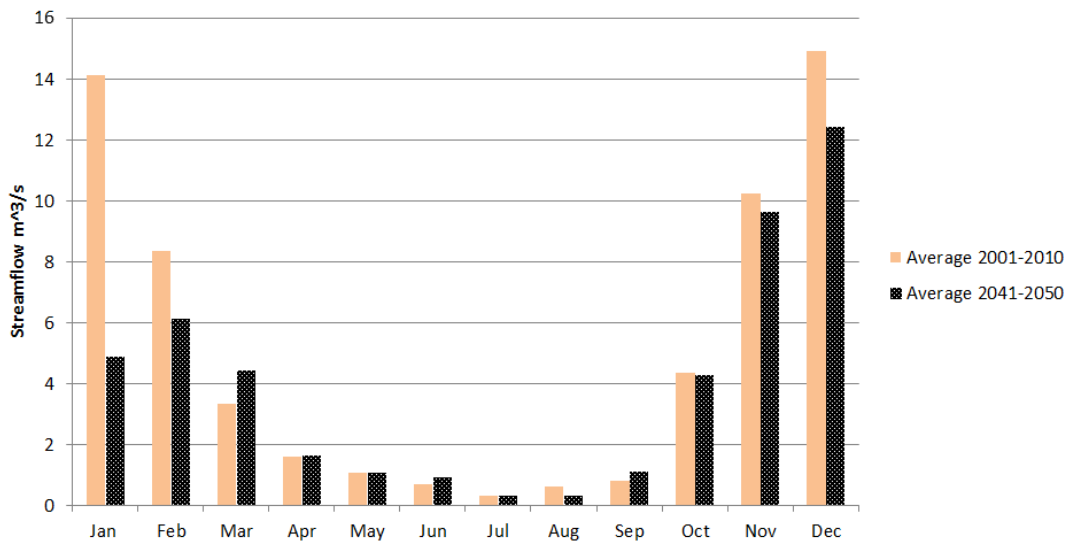
Irrigation water needs can be assumed to be equal to the evapotranspiration of the crop minus the rainfall water received by the crop. Evapotranspiration (as determined through the Penman-Monteith equation) is influenced by temperature, relative humidity, solar radiation, wind and plant characteristics (Allen *et al.*, 1998).

Evapotranspiration, precipitation and estimated irrigation demand can be seen in Table 4.7. The precipitation is lower at Mzilela than at the other farms. However, since evapotranspiration at Zava farm is much higher than at the other sites, irrigation demand here is the highest. Irrigation demand at Duvadzi is the lowest. Another observation is that the irrigation is estimated to be required only between March and August.

#### 4.5.4 Climate Change Expectations

The current conditions were simulated with SWAT up to 2050 using the climate information provided by the CSIR. The period from 2001-2010 was compared against the period from 2041-2050. This was done for the area around Zava in the Great Letaba catchment and the area around Dzumeri at the Molototsi River.

The average annual decrease in flow at Great Letaba was estimated around 22% and 16.5% at Molototsi. Rather than a general monthly decrease, the rainfall patterns appear to change. The same trend in changes is observed in both locations. The most significant change occurs in January with decreases of 65% and 62% respectively. Other decreases are less severe and in some months (March, April and September) there is actually an increase in streamflow. These observations are illustrated in Figures 4.21 and 4.22.



**Figure 4.21:** Great Letaba Monthly Streamflow: 2001-2010 and 2041-2050



**Table 4.7:** Estimation of Irrigation Demand for Farm Locations

Average Evapotranspiration (mm)													
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Zava</b>	846.66	124.15	62.59	84.62	97.22	66.62	49.20	28.20	28.08	15.63	51.52	106.40	134.24
<b>Mzilela</b>	730.63	93.49	56.16	79.18	90.14	60.93	31.19	15.57	16.79	13.06	42.27	104.61	125.63
<b>Duvadzi</b>	665.04	98.31	55.92	68.98	77.58	42.49	22.47	14.78	14.68	12.12	41.89	95.96	117.59
<b>Dzumeri</b>	738.14	107.52	57.36	75.72	89.59	63.21	30.01	15.67	16.43	11.43	44.97	100.51	124.93
Average Precipitation (mm)													
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Zava</b>	718.64	128.42	89.68	58.71	41.78	26.67	21.04	12.44	15.66	15.14	57.51	125.83	151.92
<b>Mzilela</b>	711.09	123.16	86.16	60.51	44.67	29.72	21.41	12.99	17.83	15.12	53.98	121.92	149.19
<b>Duvadzi</b>	718.64	128.42	89.68	58.71	41.78	26.67	21.04	12.44	15.66	15.14	57.51	125.83	151.92
<b>Dzumeri</b>	718.64	128.42	89.68	58.71	41.78	26.67	21.04	12.44	15.66	15.14	57.51	125.83	151.92
Average Irrigation Demand (mm)													
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Zava</b>	128.02	0.00	0.00	25.91	55.44	39.95	28.16	15.77	12.42	0.50	0.00	0.00	0.00
<b>Mzilela</b>	19.54	0.00	0.00	18.67	45.47	31.21	9.78	2.58	0.00	0.00	0.00	0.00	0.00
<b>Duvadzi</b>	0.00	0.00	0.00	10.27	35.81	15.82	1.43	2.35	0.00	0.00	0.00	0.00	0.00
<b>Dzumeri</b>	19.49	0.00	0.00	17.01	47.81	36.53	8.97	3.23	0.77	0.00	0.00	0.00	0.00

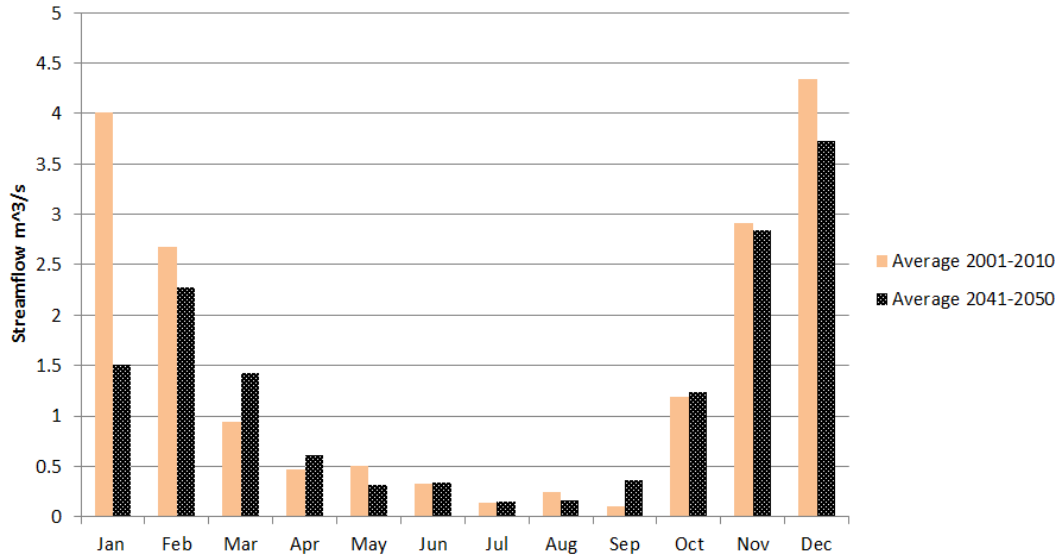


Figure 4.22: Molototsi Monthly Streamflow: 2001-2010 and 2041-2050

#### 4.5.5 Development Recommendations from Hydrological Observations

- In the event of water scarcity, crops can still be produced between September and February without irrigation demands.
- Farms along the Molototsi River require less water for irrigation than those located near the Great Letaba River (i.e. Zava), despite higher streamflow at Great Letaba.
- Rainfall patterns are predicted to change over the next 40 years. Climate needs to be monitored and management decisions need to be made adaptively.
- Streamflow changes in the Great Letaba River are more significant than in the Molototsi River.

### 4.6 Chapter Conclusion

The objective of this chapter was to apply the developed evaluation method to actual small-scale farms. The chapter also aimed to assess the results obtained by the Integrated Evaluation Model with regards to the water availability in the area. Hereby it would determine whether the farms rightfully support or do not support visions as intended by strategic documents.

The Integrated Evaluation Model as developed in Chapter 3 was validated by applying it to four small-scale farms in the Letaba catchment. The Letaba catchment has a limited water supply, but also development ambitions which might increase pressure on the area's water resources. Expansion of agriculture in particular could affect the water situation and should be developed under careful consideration. The chosen farms differ in characteristics in terms of crops, markets, location and irrigation type amongst others.

The results against strategic documents proved to be as expected for small-scale farms and indicated areas in which the farms have potential to improve. Zava measured most aligned with the eight documents, with the highest score in every category. Duvadzi had the lowest overall score. Certain scores are comparable for all farms (e.g. WAR, NFSD and NDP 2030) and deductions on the impact of small-scale farming in general can be made. However, other scores vary greatly for the farms, making it difficult to draw general conclusions, but more importantly it indicates areas of potential improvement for specific farms. This information can be used by the farm owners themselves to voluntarily contribute to the region's wellbeing or by government departments to support farms in making a positive contribution to the region as a whole.

Small-scale farms are all shown to have positive social impacts and are positively aligned to the values of WAR and the Luvuvhu/Letaba CMS. Alignment with other strategic documents varies more for each farm. As for showing areas of possible improvement, the farms can adopt practices to contribute more to the objectives of LED and NFSD. Regarding Output 2 it is confirmed that the farms have potential to contribute more economically.

The water situation in the catchment area was investigated to determine how it might affect future development planning. Climate change is expected to have the biggest impact on the water availability. Water for domestic purposes will also increase with population growth, but with less severe consequences on water available for development than climate change. This information suggests that development requiring water (such as agriculture) need to consider future decreases in the available water.

In the short term, these results did not show major discrepancies against strategic results. However, certain locations require more irrigation water than others and climate change is also expected to have more severe impacts on certain parts of the catchment. In the long run, the farm measuring most favourable in terms of "*alignment with vision*" (Zava) is in the location least desirable for agricultural expansion.

An integrated evaluation method is very valuable to indicate how a single activity such as a small-scale farm is aligned towards the vision of various local

authorities and also sustainability. Areas in which a specific farm can improve are highlighted. Evaluating a few farms simultaneously can produce further deductions, indicating general trends of alignment and the expected contribution of small-scale farming. Farms can also be compared to each other to determine potential improvement. However, expansion according to alignment with strategic visions should be done in conjunction with detailed consideration of the site location. In the long term certain sites are less favourable for development than others.

# Chapter 5

## Results and Discussion

The final chapter of this thesis mainly serves as an overview of the work discussed in the previous chapters. The chapter however concludes as an introduction to the future applications for this thesis, in terms of future work as well as contributions it can make.

### 5.1 Summary and Conclusions

There are a few identified problems with the implementation of strategic objectives, environmental management and sustainable development ideals in South Africa. This thesis aimed to address two of the problems. The first was to address the multitude of parties and their interrelated functions. A means to integrate their objectives and functions was investigated. The second problem explored alternatives to the “*regulatory approach*” in striving towards objectives and sustainability. The study intends that all activities should be aligned towards a common goal. The thesis used small-scale farms as an example of an activity to be aligned.

In Chapter 2 the complexity of strategic planning and environmental management was investigated to determine the reasons for problems with implementation. Sustainable development in South Africa was examined to determine how it is currently approached. Specific processes were studied such as EIAs and SEA for environmental management, as well as WULA as an example of an inefficient process. The literature review also explored how strategic objectives for a region are applicable to individual activities such as a small-scale farm.

An integrated, streamlined and pro-active approach was proposed from the literature review. Chapter 3 aimed to develop such a method. Certain documents were identified that deal with regional strategic planning as well as national frameworks on sustainable development, rural development and long

term development planning. All these documents were analysed and integrated to form a comprehensive evaluation guideline. This was finally reduced to be applicable specifically to small-scale farms. The developed method can be used to evaluate small-scale farms' alignment with the visions of the relevant authorities as well as their contribution to the region's sustainability.

Four actual small-scale in the Letaba catchment of Limpopo Province were evaluated with the developed Integrated Evaluation Model as validation of the method. The farms differed regarding their locations, farming practices, types of crops, markets and social characteristics of the employees and owners. The method produced sensible and useful results.

The Letaba catchment has a limited water supply and the current demand for water already exceeds the available supply. Furthermore, irrigation schemes have been discontinued in the past due to water shortages. Therefore, it is important to evaluate the practicality of small-scale farming expansion with regards to the water situation. The entire catchment's water availability was modelled with SWAT taking climate change conditions into account. The different locations of the four farms were also assessed individually. Climate change is expected to put further stress on the water supply and any development should be planned accordingly. Regarding the studied farms, farms in certain areas have less severe impacts on the catchment's water system than others. Expansion should typically be pursued in these areas. It was established that location should play an integral part when evaluating impact on sustainability. Findings derived from the implementation of the Integrated Evaluation Model on these four farms are listed and discussed below:

- Zava measures most aligned to the visions of the regulatory authorities according to the Integrated Evaluation Method. The positive alignment of Zava can be ascribed to the social aspects of female ownership and access to land as well as the high employment of 3.6 employees per hectare. Other contributing factors are the use of natural resources for economic activities and being part of a community project.
- The farm contributing least to the visions of regulating authorities is Duvadzi. Reasons for Duvadzi being least aligned to the objectives are its small crop yield for the specified season and its location being isolated from a road network.
- All the farms are very well-aligned to the visions of WAR, the CMS and ISRDS. This positive alignment can be further improved by increasing water productivity (for the sustainable use of resources), using methods for increased agricultural productivity, engaging in community projects and encouraging diversity in the workplace.

- Alignment with the visions of the NDP 2030 and NFSD measures unfavourably for all farms. It can be derived that small-scale farms in general do not make adequate contributions to the objectives of these documents. Alignment can be improved by providing the region with new or uncommon products, partaking in recycling initiatives, taking measures to adapt to climate change and by expanding trade opportunities.
- For the IDP, the SDF and LED results for the farms vary greatly. These variations in scores signify the potential and possibility of improved contributions.
- The impacts of the farms on the social sphere of sustainability are positive overall. As with the alignment to the regulatory authorities, Zava has the most positive social impact. Although all the farms do have a positive impact, Dzumeri makes the least positive social contribution.
- The farms have both negative and positive impacts on the environment. Although the farms do not have serious harmful effects on the environment, they also do not make much effort in conserving it (e.g. in terms of recycling initiatives). Dzumeri is the farm contributing most to environmental concerns, whereas Duvadzi the least.
- The economic sphere of sustainability is least contributed to by the farms under consideration. In terms of economic contribution, Mzilela scores the highest and Duvadzi the lowest.
- Although Duvadzi is least favourable in terms of strategic objectives, its location is most ideal according to irrigation demand. Conversely, Zava is best aligned with strategic objectives, but requires the most irrigation water. Zava is located at the Great Letaba River, which is predicted to be affected more by climate change than the farms near the Molototsi River.

The evaluation provided insightful and useful results which can be used to better align the small-scale farms to the visions of the regulatory authorities. Expansion and support for small-scale farming should not merely focus on social and economic growth, but should take hydrological information into account.

The information provided by this evaluation can be valuable for development planning in areas with resource constraints, since the activities contributing most to the vision of regulatory authorities can be identified. Agencies providing support to small-scale farms can also benefit from this evaluation by discovering in which ways the region as a whole can benefit from the help provided to the farm.

### 5.1.1 Achievement of Research Objectives

The objective of this thesis was “*to develop a simplified method of evaluating an individual activity in the context of regional planning and sustainable development goals.*” This objective was reached through approaching the secondary objectives as discussed below.

The goals of different parties involved in regional planning were combined as intended by evaluating them simultaneously. By combining all these objectives in one all-encompassing structure, the objective of having “*one uniform, consistent method of evaluation used by different departments and for different processes*” can be achieved as well.

Using this method to evaluate individual activities would indicate how the activities are aligned to the common vision. Unsatisfactory results would indicate areas where the activity can adjust to be better aligned or make a better contribution. Therefore, the objective to “*ensure everyone is aligned to a common vision*” can be reached through proper implementation of the method and acting on the results.

By using the developed method individual activities are compared to broad strategic objectives, usually not directly applicable to them. Here, these objectives are made applicable and accessible to “*ensure the implementation of development and sustainability objectives*”, which would otherwise not be aimed for directly by all activities in an area.

### 5.1.2 Answering of Research Questions

The primary research question of this study was to determine how the complicated collection of frameworks, strategic documents and policies can be made more accessible for quick evaluation as well as relevant to individual activities. Each chapter aimed to answer specific sub questions in order to answer the primary question.

In Chapter 2 the mentioned “*complicated collection of frameworks, strategic documents and policies*” were investigated to identify those most applicable to this study. This “*collection*” was analysed to determine how they are interrelated and how the set strategic objectives are implemented. The chapter also investigated how individual efforts can contribute in reaching strategic goals.

Chapter 3 answered questions regarding the development of the Integrated Evaluation Model. It was investigated how strategic objectives can be made relevant to individual activities (small-scale farms) and also how the method



can be structured to lessen the effort for the user.

Chapter 4 answered the question of whether the developed method can be applied to real farms and provide expected results, by applying it and analysing the outcomes. The results were also compared to area/industry specific constraints (in this case, water) to determine how the results compare with the reality.

### 5.1.3 Evaluation of Hypothesis

*“A method combining all relevant strategic documents, frameworks and policies can be applied to evaluate an individual activity’s alignment with regional planning and sustainable development objectives.”*

The hypothesis of this thesis is not rejected since a method was successfully developed which combines the mentioned strategic documents to test the alignment of an individual activity (small-scale farm) to the objectives of the documents. This test would then also supply results on the contribution to sustainable development ideals.

## 5.2 Future Work

The Integrated Evaluation Model has a few opportunities for future development.

- Since municipal, environmental, zoning, social, infrastructure and other information are associated with specific locations it would be useful to expand the developed model to incorporate GIS data. By defining the location of the farms, much information could be obtained directly from the GIS data and would lessen input effort and time of the user.
- The evaluation model can be expanded to be relevant for other activities apart from small-scale farming in a specified region. Interesting information could be gathered from such an expanded tool as different sectors could be compared against each other.
- Since the hydrological modelling showed interesting results regarding different locations and long term impacts, more detailed long term environmental assessments should be included as part of the initial assessment.
- Another opportunity would be to include, as a part of the tool, recommendations on how to improve alignment with certain criteria.

These mentioned opportunities are all possible ways in which the developed Integrated Evaluation Tool can be improved or expanded.

### 5.3 Final Remarks

This thesis proposed a method to assess alignment of individual activities (such as small-scale farming) to the objectives as envisioned by parties involved in the strategic planning of development. Although these objectives and visions are highly regarded, the implementation thereof is often deficient.

The Integrated Evaluation Model as developed in this thesis addressed this problem by making the evaluation of individual activities' alignment with strategic objectives possible. This information can be used by different levels and departments of government to assess conditions and trends in an area. Also, to indicate how the evaluated small-scale farm can make adjustments to improve its alignment with the local authorities' vision and its contribution to regional success and sustainability. There are numerous further applications regarding streamlining processes and development planning.

The Integrated Evaluation Model enables the reaching of strategic goals through a positive "*objective-led approach*" as an alternative to the more common and negative "*regulatory approach*".

## List of References

- Abrahams, D. (2003). Local Economic Development in South Africa: A Useful Tool for Sustainable Development. In: *Urban Forum*, vol. 14, pp. 185–200. Springer.
- Alexander, L., Aurora, H., Ernesto, V. and Bepsy, C. (2010). Livelihoods and Biodiversity Futures: Building Scenarios for the Têrraba River Basin, the Greater Kruger Park, the Warana River Basin, Ba Be National Park and Na Hang Nature Reserve. 2010. LiveDiverse.
- Aliber, M. and Hall, R. (2012). Support for Smallholder Farmers in South Africa: Challenges of Scale and Strategy. *Development Southern Africa*, vol. 29, no. 4, pp. 548–562.
- Allen, R.G., Pereira, L.S., Raes, D., Smith, M. *et al.* (1998). Crop Evapotranspiration-Guidelines for Computing Crop Water Requirements: FAO Irrigation and Drainage Paper 56. *FAO, Rome*, vol. 300, p. 6541.
- AMCOW (2012). Water Security and Climate Resilient Development. Tech. Rep., AMCOW.
- Anderson, A., Karar, E. and Farolfi, S. (2008). Synthesis: IWRM Lessons for Implementation. *Water SA*, vol. 34, no. 6, pp. 665–669.
- Aurecon (2010). Technical Study Module: Review of Water Requirements. In: *Groot Letaba River Development Project*. DWAF.
- Becker, B. (1998). *Sustainability Assessment: A Review of Values, Concepts, and Methodological Approaches*. CGIAR.
- Bell, S. and Morse, S. (2008). *Sustainability Indicators: Measuring the Immeasurable*. Earthscan.
- BOCMA (2010 Decemeber). Breede-Overberg Catchment Management Strategy. Tech. Rep., Breede-Overberg Catchment Management Agency.
- Cacadu District Municipality (2012). Integrated Development Plan 2012-2017. Tech. Rep., Cacadu District Municipality.
- Cashmore, M. (2004). The Role of Science in Environmental Impact Assessment: Process and Procedure Versus Purpose in the Development of Theory. *Environmental Impact Assessment Review*, vol. 24, no. 4, pp. 403–426.

- Chatterton, P. and Style, S. (2001). Putting Sustainable Development into Practice? The Role of Local Policy Partnership Networks. *Local Environment*, vol. 6, no. 4, pp. 439–452.  
Available at: <http://www.tandfonline.com/doi/abs/10.1080/13549830120091725>
- Colvin, J., Ballim, F., Chimbuya, S., Everard, M., Goss, J., Klarenberg, G., Ndlovu, S., Ncala, D. and Weston, D. (2008). Building Capacity for Co-operative Governance as a Basis for Integrated Water Resource Managing in the Inkomati and Mvoti Catchments, South Africa. *Water Sa*, vol. 34, no. 6, pp. 681–689.
- De la Harpe, J. (2006). Guide to the National Water Act. Tech. Rep., DWAF.
- DEAT (2008). People - Planet - Prosperity: A National Framework for Sustainable Development in South Africa. Tech. Rep., Department of Environmental Affairs and Tourism.
- DEAT (2010). National Climate Change Response Green Paper 2010. Tech. Rep., Department of Environmental Affairs And Tourism.
- DEAT (2011). National Strategy for Sustainable Development and Action Plan (NSSD 1) 2011-2014. Tech. Rep., Department of Environmental Affairs.
- Delius, P. and Schirmer, S. (2001). *Towards a Workable Rural Development Strategy*. Trade and Industrial Policy Strategies.
- Department of Agriculture, Forestry and Fisheries (2011 October). Smallholder development.
- Department of Economic and Social Affairs (2009). Rethinking Poverty: Report on the World Social Situation 2010. Tech. Rep., United Nations.
- Department of Land Affairs (2000). The Integrated Sustainable Rural Development Strategy. Tech. Rep., Department of Land Affairs.
- Department of Rural Development and Land Reform (2011). Guidelines for the Development of Spatial Development Frameworks. Version 8. Tech. Rep., Department of Rural Development and Land Reform.
- Department of Water Affairs (2013 September). Minister Molewa Disputes that Water Policy will Prejudice Farmers. Press Release.
- Devuyst, D., Hens, L. and Lannoy, W.D. (2001). *How Green is the City? Sustainability Assessment and the Management of Urban Environments*. Columbia University Press.
- DWA (). Screening Tool for Water Allocation Reform.  
Available at: <http://www.dwaf.gov.za/WAR/toolkit.html#>
- DWAF (1998). National Water Act, Act No. 36 of 1998. Tech. Rep., Department of Water Affairs and Forestry.

- DWAF (2004). Internal Strategic Perspective: Luvuvhu/Letaba Water Management Area. Tech. Rep., Department of Water Affairs And Forestry.
- DWAF (2007). A Toolkit For Water Allocation Reform. Tech. Rep., Department of Water Affairs and Forestry.
- DWAF (2008). Strategic Framework on Water for Sustainable Growth and Development: Summary Discussion Document. Tech. Rep., DWAF.
- DWAF (2009). Water for Growth & Development Framework: Version 7. Tech. Rep., Department of Water Affairs and Forestry.
- DWAF (2011). Development of a Reconciliation Strategy for the Luvuvhu and Letaba Water Supply System. Tech. Rep., DWAF.
- Feenstra, G.W. (1997). Local Food Systems and Sustainable Communities. *American Journal of Alternative Agriculture*, vol. 12, no. 01, pp. 28–36.
- Food and Agricultural Organization of the United Nations (2012). Sustainability Pathways: Smallholders and Sustainability. Factsheet.
- Gassman, P., Reyes, M., Green, C. and Arnold, J. (2007). The Soil and Water Assessment Tool: Historical Development, Applications, and Future Research Directions. *American Society of Agricultural and Biological Engineers*, vol. 50(4), pp. 1211–1250.
- Geach, B. and Peart, R. (1998). Land, Resource Use, Biodiversity and Desertification in South Africa: An Overview and Analysis of Post-1994 Policies, Programmes, Institutions and Financial Mechanisms. In: *Financial Innovations to Combat Desertification. 12th Global Biodiversity Forum, Dakar, Senegal*, pp. 4–6.
- Greater Giyani Municipality (2012). Greater Giyani Municipality IDP 2012-2013. Tech. Rep., Greater Giyani Municipality.
- Greater Letaba Local Municipality (2006). Local Economic Development Plan. Tech. Rep., Greater Letaba Local Municipality.
- Greater Letaba Municipality (2013). Greater Letaba Municipality IDP 2012-2017. Tech. Rep., Greater Letaba Municipality.
- Greater Tzaneen Municipality (2009). Greater Tzaneen Municipality Spatial Development Framework. Tech. Rep., Greater Tzaneen Municipality.
- Hamann, R. and O’Riordan, T. (1999). South Africa’s Policy Transition to Sustainability. International Association of Impact Assessment (South Africa), 3 - 5 September 1999.
- Helling, A. (1998). Collaborative Visioning: Proceed with Caution!: Results from Evaluating Atlanta’s Vision 2020 Project. *Journal of the American Planning Association*, vol. 64, no. 3, pp. 335–349.

- Heltberg, R. (1998). Rural market imperfections and the farm size-productivity relationship: Evidence from Pakistan. *World Development*, vol. 26, no. 10, pp. 1807–1826.
- Hunt, D.V., Lombardi, D.R., Rogers, C.D. and Jefferson, I. (2008). Application of Sustainability Indicators in Decision-making Processes for Urban Regeneration Projects. *Proceedings of the ICE-Engineering Sustainability*, vol. 161, no. 1, pp. 77–91.
- International Labour Organization (2013). Decent Work Agenda. Date accessed: 07/10/2013.  
Available at: [www.ilo.org/global/about-the-ilo/decent-work-agenda/language/en/index.htm](http://www.ilo.org/global/about-the-ilo/decent-work-agenda/language/en/index.htm)
- Jennings, P.D. and Zandbergen, P.A. (1995). Ecologically Sustainable Organizations: An Institutional Approach. *Academy of Management Review*, vol. 20, no. 4, pp. 1015–1052.
- Katambara, Z. and Ndiritu, J. (2009). A Fuzzy Inference System for Modelling Streamflow: Case of Letaba River, South Africa. *Physics and Chemistry of the Earth*, vol. 34, pp. 688–700.
- King, J. and Pienaar, H. (2011). *Sustainable Use of South Africa's Inland Waters*. Water Research Commission.
- Kirsten, J.F. and Van Zyl, J. (1998). Defining Small-Scale Farmers in the South African Context. *Agrekon*, vol. 37, no. 4, pp. 551–562.
- Klemeš, V. (1986). Operational testing of hydrological simulation models. *Hydrological Sciences Journal*, vol. 31, no. 1, pp. 13–24.
- Knickel, K. and Renting, H. (2000). Methodological and Conceptual Issues in the Study of Multifunctionality and Rural Development. *Sociologia Ruralis*, vol. 40, no. 4, pp. 512–528.
- Kole, N.M. (2005). *An Evaluation of the Integrated Sustainable Rural Development Programme Highlighting Stakeholder Mobilisation and Engagement*. Master's thesis, University of Pretoria.
- Kotze, L.J. (2006). Improving Unsustainable Environmental Governance in South Africa: The Case for Holistic Governance. *Potchefstroom Electronic Law Journal/Potchefstroomse Elektroniese Regsblad*, vol. 9, no. 1, pp. 1–44.
- Kruger, R. (2005). *A Generic Framework for Promoting the Implementation of Environmental Management Systems at Local Government Level in South Africa*. Master's thesis, North West University.
- Lappe, F. (1975). *Diet for a Small Planet*. Ballantine Books, New York.

- Lee, D.R. and Neves, B. (2009). Rural Poverty and Natural Resources: Improving Access and Sustainable Management. Background Paper for Chapter 2 of the International Fund for Agricultural Development Rural Poverty Report.
- Lepelle Northern Water (2011). Lepelle Northern Water Annual Report. Tech. Rep..
- Lerman, Z. and Sutton, W.R. (2006). Productivity and efficiency of small and large farms in moldova. In: *AAEA Annual Meeting, Long Beach, CA, July*, pp. 23–26.
- Lochner, P. (2005). Guideline for Environmental Management Plans. CSIR Report No ENV-S-C 2005-053 H, Department of Environmental Affairs & Development Planning, Cape Town.
- Maake, T. (2010). Comprehensive Rural Development: A Case Study Of Greater Giyani Municipality With Specific Reference To Muyexe Village.
- Machethe, C.L. (2004). Agriculture and Poverty in South Africa: Can Agriculture Reduce Poverty? In: *Paper presented at the Overcoming Underdevelopment Conference held in Pretoria*, vol. 28, p. 29.
- Mandlana, W. and Lamola, L. (2010 October). Backlog in Water Use Licensing Doesn't Stop Enforcement Actions by DWA. Bowman Gilfillan Attorneys October Newsletter.  
Available at: <http://www.bowman.co.za/eZines/Custom/Environment/OctoberNewsletters/EnvironmentalNewsletter.html>
- Matlala, M. (2009 March). NAFU presentation at Water for Growth and Development. Presentation at Water for Growth and Development 2009.
- M'Marete, C. (2006). Climate and Water Resource in the Limpopo Province. Tech. Rep., Department of Agriculture and Rural Engineering.
- Mochotlhi, D. (2010 March). Emergency Response Plan for Eradication of Water Use Authorisation Backlog: Letsema. Presentation to the Portofolio Committee: Water and Environment.
- Moldan, B., Janoušková, S. and Hák, T. (2012). How to Understand and Measure Environmental Sustainability: Indicators and Targets. *Ecological Indicators*, vol. 17, pp. 4–13.
- Molewa, E. (2013 May). Budget Speech: Water is Life: Respect It, Conserve It, Enjoy It. Budget Speech.
- Mopani District Municipality (2013). Integrated Development Plan 2011-2016. Tech. Rep., Mopani District Municipality.
- Moriasi, D., Arnold, J., van Liew, M., Bingner, R., Harmel, R. and Veith, T. (2007). Model Evaluation Guidelines for System Quantification of Accuracy in Watershed Simulation. *American Soc*, vol. 50(3), pp. 885–900.

- Mouton, J. (2011). *How to Succeed in your Master's and Doctoral Studies*. 15th edn. Van Schaik Publishers.
- Movik, S. (2013). Perceptions of Justice in South Africa's Water Allocation Reform Policy. *Geoforum*, vol. Unknown, p. Unknown.  
Available at: <http://dx.doi.org/10.1016/j.geoforum.2013.03.003>
- Msibi, M.I. and Dlamini, P.Z. (2011 October). Water Allocation Reform in South Africa: History, Processes and Prospects for Future Implementation. Tech. Rep., Water Research Commission. WRC Report.
- National Planning Commission (2012). National Development Plan 2030: Our Future- make it work. Tech. Rep., Republic of South Africa.
- Nattrass and Altomare (1999). *The Natural Step for Business : Wealth, Ecology and the Evolutionary Corporation*. New Society Publishers.
- Nieuwoudt, W.L., Backeberg, G. and Du Plessis, H. (2004). The Value of Water in the South African Economy: Some Implications. *Agrekon*, vol. 43, no. 2, pp. 162–183.
- Nkondo, M., Van Zyl, F., Keuris, H. and Schreiner, B. (2012 July). Proposed National Water Resource Strategy 2 (NWRS 2): Summary. DWAF.
- Parker, F. (2013 September). Water Finally Rises to SA's Development Agenda.  
Available at: <http://mg.co.za/article/2013-09-04-water-finally-rises-to-sas-development-agenda>
- Perkins, J. (2000 May). The Assessment of Water Use Authorisations and Licence Applications in Terms of Section 27(1) of the National Water Act, 1998. Presented at WISA 2000 Biennial Conference, Sun City, South Africa (28 May - 1 June 2000).
- Perret, S.R. (2001). Poverty And Diversity of Livelihood Systems in Post-Apartheid Rural South Africa: Insights into Local Levels in the Eastern Cape Province. In: *Agrarian Development-EAAE Seminar, Livelihoods and Rural Poverty*, Wye.
- Perret, S.R. (2002). Water Policies and Smallholding Irrigation Schemes in South Africa: A History and New Institutional Challenges. *Water Policy*, vol. 4, no. 3, pp. 283–300.
- Pope, J., Annandale, D. and Morrison-Saunders, A. (2004). Conceptualising Sustainability Assessment. *Environmental Impact Assessment Review*, vol. 24, no. 6, pp. 595–616.
- Purschwitz, M.A. and Field, W.E. (1990). Scope and Magnitude of Injuries in the Agricultural Workplace. *American Journal of Industrial Medicine*, vol. 18, no. 2, pp. 179–192.
- Ravetz, J. (2000). Integrated Assessment for Sustainability Appraisal in Cities and Regions. *Environmental impact assessment review*, vol. 20, no. 1, pp. 31–64.



- Republic of South Africa (1998). Act No. 107, 1998 NATIONAL ENVIRONMENTAL MANAGEMENT ACT.
- Retief, F. (2007). A Performance Evaluation of Strategic Environmental Assessment (SEA) Processes within the South African Context. *Environmental Impact Assessment Review*, vol. 27, no. 1, pp. 84–100.
- Ridaura, S.L. (2005). *Multi-Scale Sustainability Evaluation. A Framework for the Derivation and Quantification of Indicators for Natural Resource Management Systems*. Wageningen University and Research Centre.
- Rorarius, J. (2007 August). *Existing Assessment Tools and Indicators: Building up Sustainability Assessment (Some Perspectives and Future Applications for Finland)*.
- Rossouw, N. and Wiseman, K. (2004). Learning from the Implementation of Environmental Public Policy Instruments after the First Ten Years of Democracy in South Africa. *Impact Assessment and Project Appraisal*, vol. 22, no. 2, pp. 131–140.
- Rydin, Y. (1998). Land Use Planning and Environmental Capacity: Reassessing the Use of Regulatory Policy Tools to Achieve Sustainable Development. *Journal of Environmental Planning and Management*, vol. 41, no. 6, pp. 749–765.
- Sandham, L., Van Heerden, A., Jones, C., Retief, F. and Morrison-Saunders, A. (2013). Does Enhanced Regulation Improve EIA Report Quality? Lessons from South Africa. *Environmental Impact Assessment Review*, vol. 38, pp. 155–162.
- Scheffler, C. (2008). *Development of a Downscaling Scheme for a Coarse Scale Soil Water Estimation Method Case Study - Great Letaba River in South Africa*. Ph.D. thesis, Friedrich-Schiller-Universität Jena.
- Statistics South Africa (2008). Community Survey, 2007. Basic Results: Communities. Pretoria.
- Swilling, M. (2008). Local Governance and the Politics of Sustainability. *Consolidating Developmental Local Government: Lessons from the South African Experience*, pp. 77–108.
- Todes, A., Sim, V. and Sutherland, C. (2009). The Relationship Between Planning and Environmental Management in South Africa: The Case of KwaZulu-Natal. *Planning, Practice & Research*, vol. 24, no. 4, pp. 411–433.
- Tshikolomo, K.A., Walker, S. and Nesamvuni, A.E. (2012). Rainfall influence on water gain and loss from Middle Letaba Dam in Luvuvhu-Letaba Water Management Area, South Africa. *International Journal of Applied Science and Technology*, vol. 2, pp. 24–33.
- United States Environmental Protection Agency (2003 July). *National Management Measures to Control Nonpoint Source Pollution from Agriculture*. Chapter 4: Management Measures.

Walmsley, J.J. (2002). Framework for Measuring Sustainable Development in Catchment Systems. *Environmental Management*, vol. 29, no. 2, pp. 195–206.

WCED (1987). *Our Common Future*. Oxford : Oxford University Press.

# Appendix A

## User Interface

The Integrated Evaluation Model as developed in Microsoft Excel is presented here. Values entered are for Mzilela farm.

### A.1 Input

#### GENERAL INFORMATION:

Name of farm:	Mzilela
Sub-basin of farm (indicated on map)	39
Size	24 ha

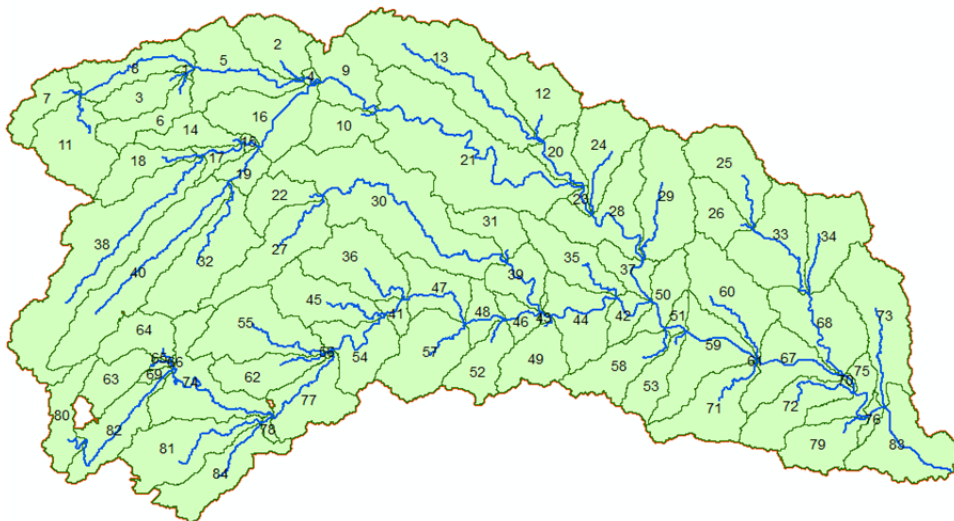


Figure A.1: General Input Information

**CROP INFORMATION:**

		Type of Crops	Tonnes/ha
Productivity and types of crops:	Crop 1	Maize	1.18
	Crop 2	Pumpkin	0
	Crop 3	Tomatoes	0.13
	Crop 4	Beetroot	0
	Crop 5	Spinach	0.1
	Crop 6	Okra	0.14
	Crop 7	Ground nuts	0
	Crop 8	None	

Figure A.2: Crop Information

**IRRIGATION INFORMATION:**

Which type of irrigation system is used?	Drip
What is the source for irrigation water?	Borehole
Does the farm make use of any measures for the efficient use of water? (Apart from type of irrigation system used)	Yes
Does the farm have a Water Use Licence? Or is the water use registered?	Yes
How much water is needed per season (average)? (m3)	25850.4
Is a previously developed irrigation scheme used?	No
Is recycled/grey water used for irrigation?	No
Does the farm have a new farm dam or plan to build one?	No
Does the farm have a new irrigation scheme or plan to have one?	No

Figure A.3: Irrigation Input Information

**SOCIAL INFORMATION:**

Is the owner a Historically Disadvantaged Individual (HDI)?	Yes
What gender is the owner?	Female
How many people are employed by the farm?	17
How many employees are female?	15
How many employees are male?	2
How many employees are HDI's or poor?	17
Are any young people involved in the farms activities? How many?	3
How many unskilled workers are employed?	17
Are there diversity amongst the employees?	No
Is the farmer skilled?	No
Do the farmer/employees receive any training?	Yes
Does the farmer have access to external knowledge/support or technical support?	Yes
Does the farmer/employees have any skills other than farming?	Yes
Is the farm part of a programme for productive use of water?	Yes
Is the farm part of a Water User Association?	No
Is the farm part of any type of community project/co-operation?	Yes
Is the farm part of a partnership with different sectors and spheres?	No

**Figure A.4:** Social Input Information

**RIGHTS AND SAFETY AT WORK:**

Are all of the workers of the age of 15?	Yes
Are the wages of the workers at least R2273.52/ month, R524.70/week, R105.00/day or R11.6/hour?	No
Does the workers work less than 45 hours per week, with meal intervals after a maximum of 5 hours of work?	Yes
Do workers receive sick leave, family responsibility leave and maternity leave?	Yes
<hr/>	
Does any employee operate machinery without required training?	No
Are there dangerous chemicals involved in farming activities?	Yes
Are all employees aware of the dangers of these chemicals?	Yes
Is the farm in an area experiencing extreme temperatures?	Yes
Is the working environment in close proximity to diseased animals?	No
Are there any health surveillance measures for young workers, pregnant and nursing women and aged workers?	No
Does the work require inadequate postures?	Yes
Are there provision of first aid, antidotes or other emergency procedures in case of contact with poisonous animals, insects or plants?	No

**Figure A.5:** Rights and Safety at Work Input Information

## MARKET INFORMATION:

---

### *Supply chain information*

Does the farm supply directly to households?	Yes
Does the farm supply directly to local market?	Yes
Does the farm supply to local agro-processors?	No
Does the farm supply to a national market?	Yes
Does the farm export?	No
To other Southern Africa countries?	
To BRICS countries?	
Do the farm's buyers use the farm's produce to export products?	No
Are the majority of the buyers from a different race/language/religion than the farmer?	Yes
Does the farm obtain majority of supplies from suppliers within their local municipal area?	Yes
Are the majority of the suppliers from a different race/language/religion than the farmer?	Yes

### *Product Information*

Does the farm have any agro-processing activities as part of their farm?	No
Does the farm provide any new or uncommon products or crops to the area?	No
Does the farm make use of any natural resources as part of economic activities?	Yes

**Figure A.6:** Market Input Information

## FARMING PRACTICES AND GENERAL OPERATIONS:

---

Are any pesticides used?	Yes
Are any fertilizers used?	No
Are agricultural waste used for fertilizer?	
Does the farm rotate livestock and crops?	No
Is mixed cropping applied?	No
Does the farm use any other new or high technology practices to increase productivity?	No
Are any measures taken to trap or retain waste from contaminating surface water and groundwater?	No
Are renewable resources used for electricity use?	No

Figure A.7: Farming Practices and General Operations

## TRANSPORT:

---

### Employees:

What mode of transport is used by the majority of employees to travel to work?	Walking
--	---------

### Products:

What mode of transport is used for the transportation of produce to markets?	Trucks
How often are produce transported to the markets?	Weekly
What is the distance (km) to the market?	50

Figure A.8: Transport Input Information



**GENERAL ENVIRONMENTAL IMPACTS:**

---

Are any native vegetation removed or affected apart from cultivated land?	No
Does the farm use any soil-erosion control actions?	Yes
Is the farm part of a road network?	Yes
Is the farm located near a town (or identified growth point)? (within 10km)	No
Is the farm located on land zoned as agricultural land?	Yes
Does the farm undertake any activities (such as burning) which affects the quality of air?	Yes

**Figure A.9:** General Environmental Input Information

## A.2 Output 1

NFSD		57.14%
	Access to land for the rural poor	✓
	Access to resources for the rural poor	✓
	Recycling initiatives	x
	Green transport	✓
	Renewable energy	x
	Alternative business models such as coope-ratives and community associations	✓
	Climate adaptation strategies	x
	Black Economic Empowerment (BEE) programmes	✓
	Inclusion of both men and women	✓
	Threaten bio-diversity	x
	Soil-erosion control	✓
	Water use efficiency technologies	✓
	Nutrient management	x
	Diversification of economies/industries	x

Figure A.10: Output: NFSD

NDP2030		61.54%
	Access to land for the rural poor	✓
	Skills and capacity development	✓
	Access to land and finance for rural women entrepreneurs	✓
	Food security	x
	Support of entrepreneurs	✓
	Inclusion of both men and women	✓
	Water use efficiency technologies	✓
	Crops with high employment potential	✓
	Increase exports and expand trade and investment	x
	Employment of young/unskilled workers	✓
	Water reuse and desalination	x
	Cooperation within BRICS countries	x
	Promoting deeper regional integration in southern Africa	x

Figure A.11: Output: NDP 2030

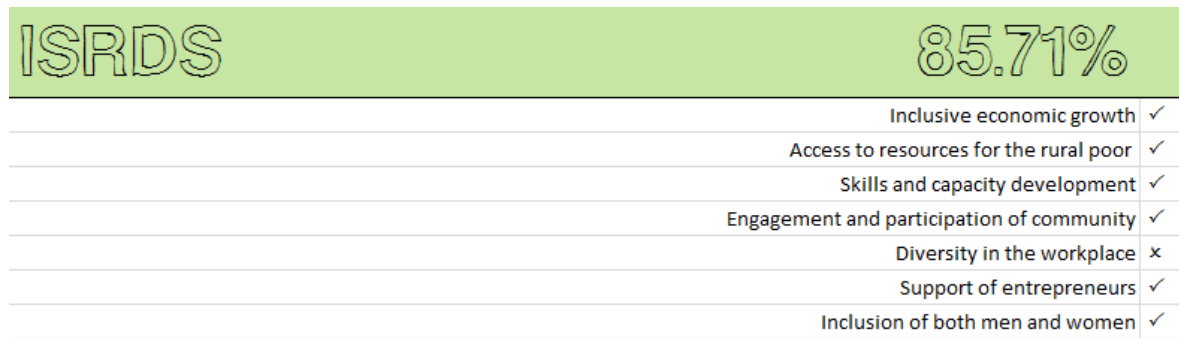


Figure A.12: Output: ISRDS

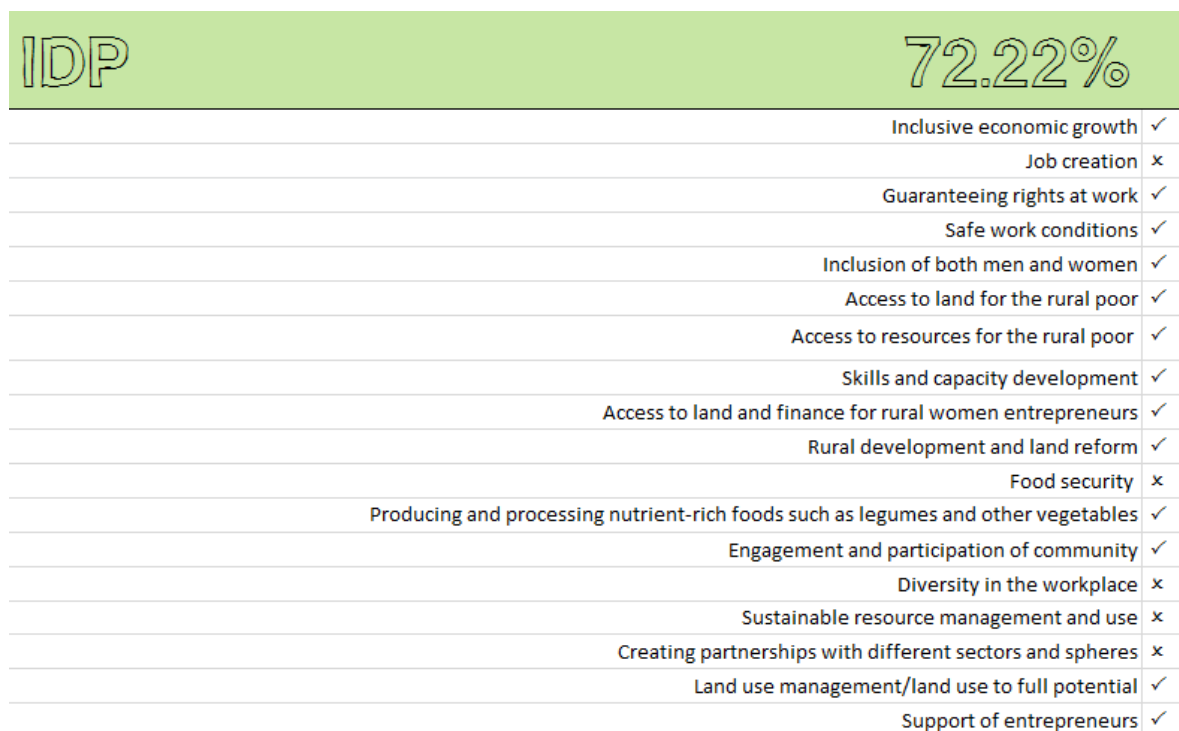


Figure A.13: Output: IDP

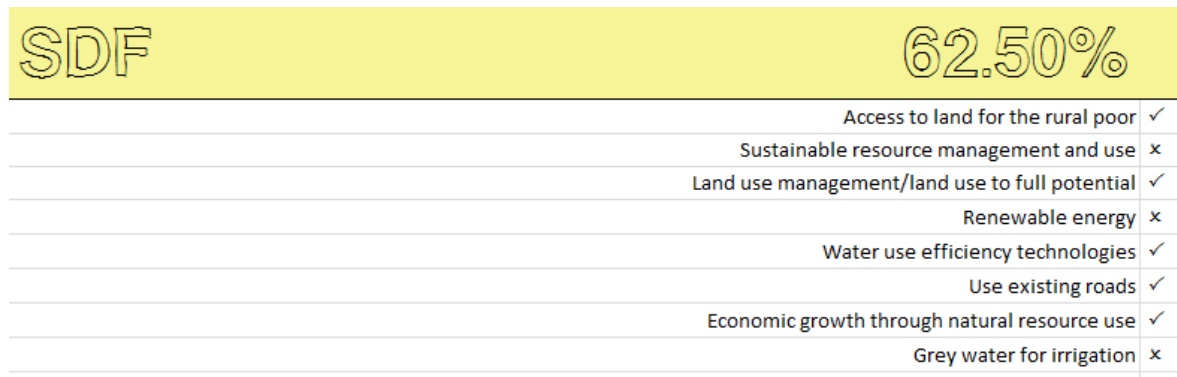


Figure A.14: Output: SDF

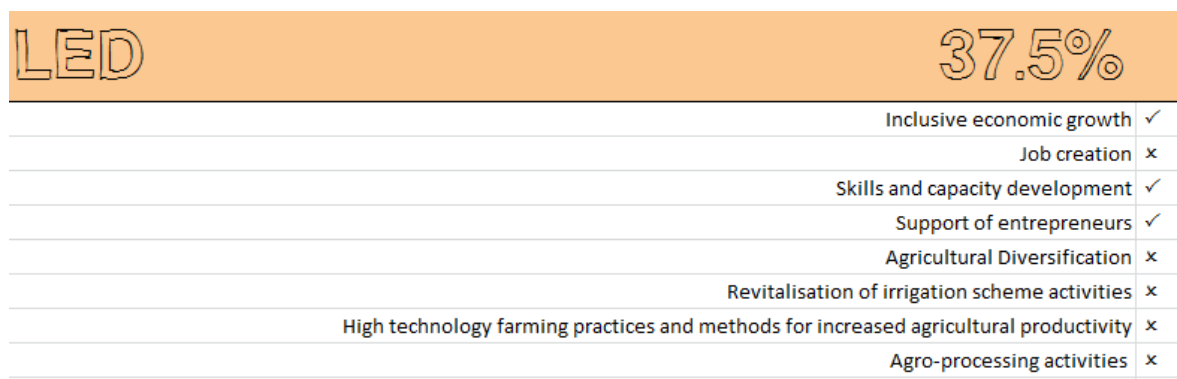


Figure A.15: Output: LED



Figure A.16: Output: CMS

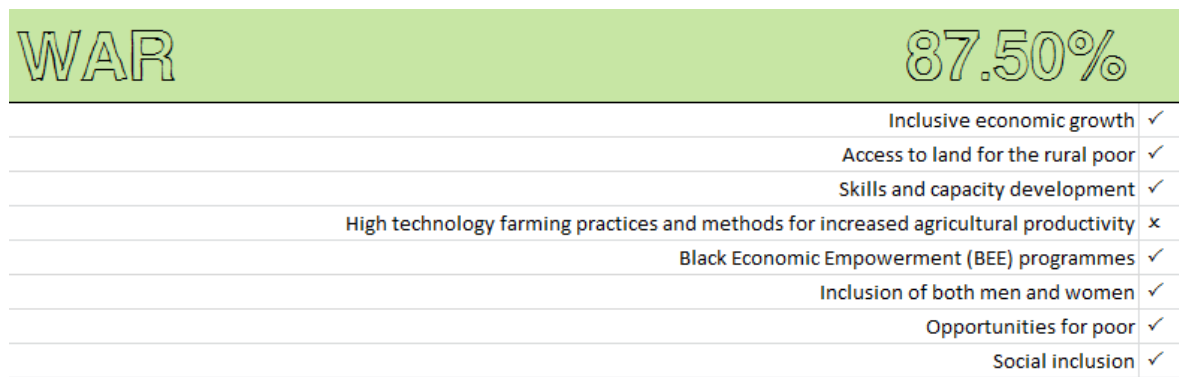


Figure A.17: Output: WAR

## A.3 Output 2

<b>SOCIAL</b>	
<b>Opportunities</b>	<b>D</b>
<b>Employment potential of type of agriculture</b>	<b>B</b>
<b>Social inclusion</b>	<b>A</b>
<b>Skills development/capacity development</b>	<b>A</b>
<b>Rights at work</b>	<b>B</b>
<b>Safety at Work</b>	<b>B</b>
<b>Household food security</b>	<b>C</b>

Figure A.18: Output: Social

<b>ENVIRONMENTAL</b>	
<b>General Water score</b>	<b>B</b>
<b>General Environment (Other)</b>	<b>B</b>
<b>Recycling initiatives/ waste</b>	<b>C</b>
<b>Effect on biodiversity</b>	<b>B</b>
<b>Development Planning</b>	<b>B</b>

Figure A.19: Output: Environmental

<b>ECONOMIC</b>	
<b>Develop local economy</b>	<b>B</b>
<b>Expand trade and investment</b>	<b>C</b>
<b>Climate adaptation strategies</b>	<b>C</b>

Figure A.20: Output: Economic

## Appendix B

# SWAT Model for Letaba Catchment

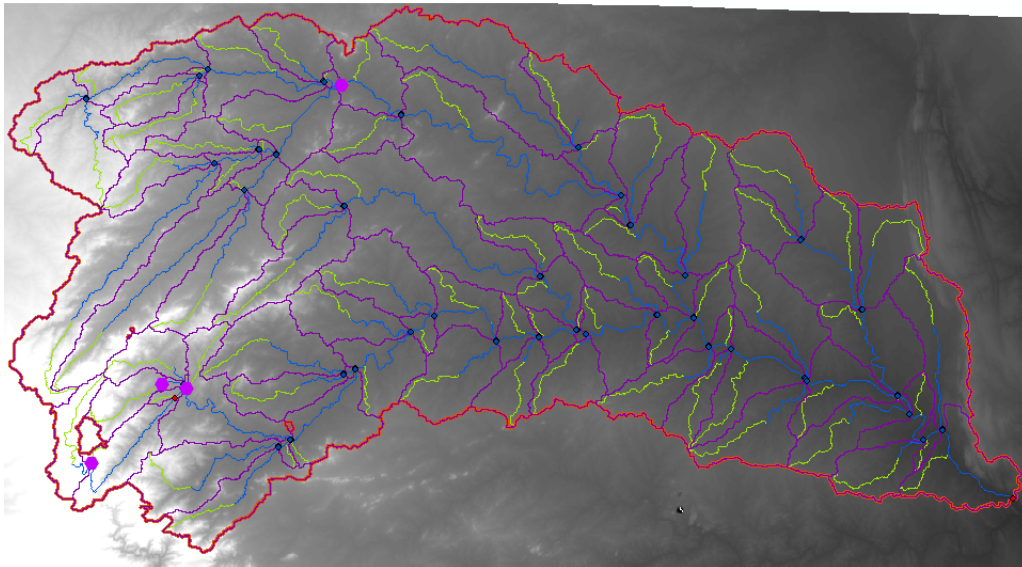
### B.1 Watershed Delineation

Stream definition: DEM based (SRTM 90m DEM)

Area:9506

Sub-basin outlet: at outlet of catchment and at reservoirs

Number of sub-basins: 84



**Figure B.1:** Watershed Delineation



## B.2 Land Use

Land use is derived from the National Land-Cover 2000. The 49 land-use types were converted into 12.

- Woodland
- Bushland & High Fynbos
- Grassland
- Forest Plantations
- Water
- Bare Soil
- Degraded Bushland & High Fynbos
- Cultivated and Irrigated (Commercial)
- Cultivated Dryland (Commercial)
- Cultivated and Irrigated (Semi-Commercial)
- Cultivated Dryland (Semi-Commercial)
- Urban/Built-Up

## B.3 Soils

The SOTER for Southern Africa soil map was used to derive a soil map for the study area. All the SOTER soils in the area were grouped into 17 new types. The available soil characteristics were used and the unknown parameters were compared to similar soils in the SWAT database (as indicated in Table B.3).

## B.4 Climate Data

Climate data simulated by the CSIR were used as climate input. This data incorporates the effects of climate change and ranges up to 2050 on a scale of 500m by 500m. The simulated weather was compared with observed weather data from the region. The observed data showed clearly that rainfall is much higher in the western part of the catchment. The simulated data showed the same pattern, however the western part does not have a significantly higher rainfall as it should. Since, the eastern region forms part of the Kruger National Park, this would not effect decisions made for small-scale farmers.

**Table B.1:** SOTER and SWAT Soils

Simplified group name	All SOTER soils in group	Original SWAT soil
ZA93	ZA93, ZA101, ZA138, ZA144, ZA171, ZA174, ZA179, ZA192, ZA196, ZA228, ZA272, ZA283, ZA291, ZA126	Lordstown
ZA98	ZA98, ZA122, ZA120, ZA146, ZA157, ZA182, ZA189, ZA185, ZA201, ZA232, ZA244, ZA273	Enosburg
ZA129	ZA129, ZA139, ZA149, ZA164, ZA168, ZA220, ZA281	Knickerbocker
ZA135	ZA135, ZA148	Duxbury
ZA160	ZA160, ZA258	Kars
ZA190	ZA190	Adams
ZA233	ZA233	Pits
ZA279	ZA279	Adams
ZA202	ZA202	Amena
ZA121	ZA121	Buckland
ZA172	ZA172, ZA204	Farmington
ZA207	ZA207, ZA242	Westbury
ZA145	ZA145, ZA282	Benson
ZA137	ZA137, ZA163, ZA165, ZA219, ZA271, ZA276, ZA278	Searsport
MZ16	MZ16	Benson
ZA170	ZA170, ZA240, ZA261, ZA245, ZA243, ZA262	Livingston
ZA205	ZA205	Peacham

## B.5 Evapotranspiration

The Penman-Monteith method was used to calculate evapotranspiration. According to Scheffler (2008) potential evapotranspiration in the Limpopo Province ranges between 1250 mm and 1899 mm per year. Another study stated potential evapotranspiration ranges from 1300 mm per year in the west to 2000 mm per year in the east of the catchment. Furthermore Scheffler (2008) estimated the ratio between evapotranspiration and rainfall ranges between 82% and 99% and evapotranspiration ranges between 473 mm and 861 mm.

The results for evapotranspiration for the SWAT model of this study is summarised in Table B.2. The evapotranspiration of two sub-basins were tested on each of the ends of the catchment. The average of each sub-basin measured over 14 years are shown. The values correspond very well with the measured values.

**Table B.2:** Evapotranspiration Validation

	Sub-basin	Land use	PET (mm)			ET(mm)	Rainfall	ET/
			Mean	Max	Min	Mean		Rainfall
East	73	BUSH	1874	2052	1631	684	747	92
	67	WOOD	1890	2069	1644	623	752	83
West	81	FOREST	1592	1755	1415	653	772	85
	38	BUSH	1515	1667	1332	533	650	82

## B.6 Irrigation

According to the South African National Land-Cover 2000 dataset, 0.08% (i.e. 1090 ha) of the catchment area is semi-commercial or subsistence irrigated area. However, 7.17% (i.e. 97 656 ha) is covered by semi-commercial or subsistence dryland farming.

Commercial irrigation according to the SWAT model requires an average of 152 Mm<sup>3</sup>/a as an average over 10 years to irrigation which is close to the actual value of 158 Mm<sup>3</sup>/ a.

## B.7 Reservoirs

Four of the most significant reservoirs in the catchment was included as reservoirs (i.e. Tzaneen Dam, Middle Letaba Dam, Magoebaskloof Dam and Ebenezer Dam), while three others was modelled as ponds. Abstractions for domestic, industrial and transfer purposes are shown in Table B.7. Water for commercial irrigation is also abstracted from the reservoirs.

**Table B.3:** Consumptive Use of Dams. Adapted from: Aurecon (2010); Lepelle Northern Water (2011); Tshikolomo *et al.* (2012)

Reservoir ID		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	Magoebaskloof	$10^4/day$	0.67	0.62	0.61	0.57	0.57	0.61	0.61	0.63	0.61	0.63	0.67
2	Ebenezer Dam	$10^4/day$	5.49	5.07	5.03	4.73	4.73	5.03	5.03	5.20	5.03	5.20	5.49
3	Tzaneen Dam	$10^4/day$	2.60	2.40	2.38	2.16	2.24	2.38	2.38	2.46	2.38	2.46	2.60
4	Middel Letaba	$10^4/day$	9.52	8.79	8.73	8.20	8.20	8.73	8.73	9.02	8.73	9.02	9.52