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DESIGN AND IMPLEMENTATION EVALUATION OF WESTERN CAPE DEPARTMENT OF AGRICULTURE PROGRAMME 2- SUSTAINABLE RESOURCE MANAGEMENT: FINAL 1/3/25 REPORT

Impact Economix

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Table of Contents

Table of Contents ... ii
ACKNOWLEDGEMENTS ... iv
LIST OF ACRONYMS ... v
FORMAT OF THE REPORT ... vii
POLICY SUMMARY ... viii
EXECUTIVE SUMMARY ... ix

1 INTRODUCTION ... 1
1.1 Report purpose ... 1
1.2 Background to the Programme: SRM ... 1
1.3 Methodology and limitations ... 2

2 Main findings ... 2
2.1 SRM staff survey findings ... 2
2.2 SRM Engineering Services: ... 4
2.3 SRM: LandCare ... 5
2.4 SRM Land-use Management: ... 7
2.5 SRM: Disaster Risk Management ... 8
2.6 Fourth Industrial Revolution Opportunities ... 9

3 Conclusions and Theory of Change for improved Programme: SRM ... 13
3.1 Conclusions ... 13
3.2 Theory of Change for a more effective Programme: SRM ... 14
3.3 Recommendations ... 19
3.4 Next steps ... 25

REFERENCES AND CONSULTED DOCUMENTS ... 26

Annexure 1: Detailed Methodology ... 31

Annexure 2: Identified Gaps, Challenges and Opportunities for SRM sub-programmes ... 41

Annexure 3: Definitions and overview of key concepts relevant to the Programme: SRM ... 54

Annexure 4: Summary of the May 2019 Draft National Policy on Conservation Agriculture ... 79

Annexure 5: Conservation Agriculture Proposals made by AgriSA in its 2017 comment on South Africa's carbon tax ... 81

Table 1 Fourth Industrial Revolution Evaluation Recommendations applicable to Programme: SRM 10
Table 2 Additional Fourth Industrial Revolution opportunities for Programme: SRM to explore further 11
Table 3 Refined SRM evaluation questions 31
Table 4 Case studies for SRM Evaluation 36
Table 5 SRM: Engineering services: Gaps, opportunities and constraints 41
Table 8 Programme SRM: LandCare Management: Gaps, opportunities, constraints 45
Table 6 Programme SRM: Land-Use Management: Gaps, opportunities, constraints 48
Table 7 Programme SRM: Disaster Risk Management: Gaps, opportunities, and constraints 50
Table 9 Key concepts and definitions relevant to the scope of this SRM programme evaluation 54

Figure 1 Theory of Change Summary for more effective Programme: SRM 16
Figure 2 SRM Evaluation Framework 31

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- The Programme: SRM current and past staff who responded to the staff survey carried out for this evaluation.
- The wide range of stakeholders who agreed to be interviewed for this evaluation and who contributed their time and expertise.

LIST OF ACRONYMS

AOI	Agriculture Orientation Index
AFFStrat	Agriculture, Forestry and Fisheries Strategic Framework
APAP	Agricultural Policy Action Plan
AISS	Alien Invasive Species Strategy
APP	Annual Performance Plan
ARC	Agricultural Research Council
CA	Conservation Agriculture
CARA	Conservation Of Agricultural Resources Act 43 OF 1983
CASIDRA	Cape Agency for Sustainable Integrated Development in Rural Areas
CASP	Comprehensive Agricultural Support Programme
CBA	Critical Biodiversity Areas
CBD	Convention on Biological Diversity
CBOs	Community Based Organisations
CCAW	Coordinating Committees on Agricultural Water
CMA	Catchment Management Agencies
CSA	Climate-smart agriculture
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries.
DALRRD	Department Agriculture, Land Reform and Rural Development
DEA	Department of Environmental Affairs
DEDAT	Department of Economic Development and Tourism
DoA	Department of Agriculture
DORA	Division of Revenue Act
DPW	Department of Public Works
DPWI	Department of Public Works and Infrastructure
DRD	Drought Risk Dashboard
DRDLR	Department of Rural Development and Land Reform
DRM	Disaster Risk Management
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessments
FAO	Food and Agricultural Organisation
FSD	Farmer Support and Development
GHG	Greenhouse gases
HR	Human Resources
ICT	Information communications technology
IWRM	Integrated Water Resources Management
KEQ	Key Evaluation Question
KPA	Key Performance Area
KPI	Key Performance Indicator
LUPA	Land Use Planning Act
M&E	Monitoring and evaluation
NDMC	National Disaster Management Centre
NDMF	National Disaster Management Framework
NDP	National Development Plan

NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
OECD DAC	Organisation for Economic Cooperation and Development's Development Assistance Committee
PDA	Provincial Department of Agriculture
PDALB	Preservation and Development of Agricultural Land Bill
PDMC	Provincial Disaster Management Centre
R&TDS	Research and Technology Development Services
SALA	Subdivision of Agricultural Land Act
SDFs	Spatial Development Frameworks
SFDRR	Sendai Framework for Disaster Risk Reduction (2015)
SO	Strategic Objectives
SPLUMA	Spatial Planning and Land Use Management Act
SRM	Programme: Sustainable Resource Management
SRM: DRM	Sustainable Resource Management: Disaster risk reduction sub-programme
SRM: LUM	Sustainable Resource Management: land use management sub-programme
SWMP	Sustainable Water Management Plan
ToC	Theory of Change
TOR	Terms of Reference
UN	United Nations
WC	Western Cape
WCAPPP	Western Cape Agricultural Protection Policy and Plan
WCDMF	Western Cape Disaster Management Framework
WCDoA	Western Cape Department of Agriculture
WCG	Western Cape Government
WRM	Water Resource Management
WUA	Water user associations

FORMAT OF THE REPORT

This evaluation report is divided into four main sections as follows:

1. Policy Summary of the Evaluation.
2. Executive summary.
3. Main Evaluation Report.
4. Annexures.

The policy summary of the evaluation contains evaluation's main policy recommendations for senior decision-makers.

The executive summary provides a snapshot of the whole evaluation. This includes the aim of the evaluation, the key findings, and the main conclusions and recommendations.

The structure of the main report is as follows:

1. Introduction, background and methodology
2. Overview of the Programme: SRM
3. Findings from the Programme: SRM staff survey
4. Findings for each of the SRM: Programme sub-programmes:
    a. SRM: Engineering
    b. SRM: LandCare
    c. SRM: Land-Use Management (SRM: LUM)
    d. SRM: Disaster Risk Management (SRM: DRM)
5. Conclusions and Recommendations.
6. Annexures:

Annexure 1:	Detailed evaluation methodology
Annexure 2:	Identified Gaps, Challenges and Opportunities for SRM sub-programmes
Annexure 3:	Definitions and overview of key concepts relevant to the Programme: SRM
Annexure 4:	Summary of the May 2019 Draft National Policy on Conservation Agriculture
Annexure 5:	Conservation Agriculture Proposals made by AgriSA in its 2017 comment on South Africa's carbon tax

A separate long evaluation report version is available (which contains the detailed case studies) as well as a separate policy and legislation desk-top review report.

POLICY SUMMARY

The Programme: Sustainable Resource Management (SRM) aims to support and ensure the agriculture sector's sustainable use of natural resources and agricultural productivity.

The purpose of this evaluation is to assess the Programme: SRM's design and implementation and to propose interventions that could improve the programme's ability to effectively deliver on its mandate. The evaluation includes seven case studies and data was collected from 60 key informant stakeholder interviews and 54 SRM current and past staff survey responses.

SRM Engineering Services: For various reasons, there has been a gradual reduction in the provision of engineering design support to commercial farmers over the past decade and it has not been possible for SRM: Engineering Services to keep up to date with numerous technological developments. The water resource management and irrigation roles played by this sub-programme are of strategic importance to agriculture in the Western Cape (WC) and promises to make a widespread impact on expanding agricultural production and improving agricultural productivity for farmers- staff knowledge and capacity to continue performing this role must therefore be continuously developed and transferred. The provision of river rehabilitation structures also plays an important role and a pro-active approach in the form of a river rehabilitation strategy and implementation plan is proposed to enhance effectiveness. This sub-programme's mechanisation, animal structures, and agro-processing services also contribute to the sustainable use of agricultural resources opportunities exist to increasingly utilise newer technologies such as small-scale solar powered agro-processing equipment.

SRM: LandCare: LandCare's engineering capacity has been weakened over the past decade, however, opportunities exist to strengthen its contribution towards assisting farmers with god farming practices. This will require a strengthening of technical engineering staff skills and services provided and further focusing of its engineering skills base (including minimising the use of engineer's time on project management). In addition, the sub-programme needs to ensure that it has staff with the necessary skills set to focus on stakeholder coordination and facilitation roles to support healthy agro-ecosystems (including soil erosion, conservation and health through soil conservation works, farm plans and river rehabilitation works). An opportunity also exists to shift the current approach towards a more focused and efficient approach for natural resource management interventions, e.g. Using clear prioritisation criteria for Alien Vegetation Clearing (AVC) aligned with the Western Cape Alien Invasive Species Strategy (AISS).

SRM Land-use Management (SRM: LUM): SRM LUM operates in a complex environment (which sometimes involves political interference in application processes) and is currently unable to meet the demands currently placed on it for comments on development applications. There is a need to take forward a range of pro-active initiatives to reduce the commenting work-load and additional human resource capacity will be required to make this possible.

SRM: Disaster Risk Management (SRM: DRM): The demands on this sub-programme are growing due to the increasing frequency, magnitude and costs of natural disasters as well as the need to implement more pro-active disaster mitigation, prevention, and risk assessment, planning and preparedness measures to build resilience in the agricultural sector to minimise the future impacts and costs of disaster (both broader economic costs on the agricultural sector, as well as costs to government of providing disaster support relief).

Key recommendations

To enhance the ability of SRM to achieve its mandate and contribute effectively towards agriculture's sustainable use of soil, land and water resources in particular, a new organisational design needs to be developed and which addresses human resource capacity and other measures to address focus areas and priorities identified in this evaluation.

To strengthen the role and contribution of SRM, as well as other WCDoA Programmes, towards promoting sustainable use of agricultural natural resources to ensure healthy agro-ecosystems (incl. healthy soils), a Western Cape Conservation Agriculture (CA) Strategy and Implementation Plan needs to be developed. In addition, a more focussed approach to LandCare projects and services must be developed (including developing a formal Provincial LandCare Strategy and Implementation Plan) so that support is focused on clearly defined priorities relevant in each District.

EXECUTIVE SUMMARY

Background

The Western Cape Department of Agriculture (WCDoA) has commissioned a design and implementation evaluation of the Programme: Sustainable Resource Management (SRM). This evaluation includes identifying internal and external constraints, as well as opportunities (refer to Annexure 2 for further details), that are relevant to the ability of the Programme: SRM to effectively deliver on its mandate, as well as making proposals that could improve the programme's ability to effectively deliver on its mandate.

The Programme: SRM's main activities are aimed at supporting the agriculture sector's sustainable use of natural resources which includes Engineering advisory services, (water resource management and irrigation, mechanisation, animal structures, and agri-processing), LandCare advisory services and projects (including alien clearing, area-wide planning, farm planning), Land-use management (SRM: LUM) to comment on land-use management applications and Environmental Impact Assessments (EIAs), and Disaster risk management (SRM: DRM) to mitigate the impact on the agricultural sector of natural hazards.

To achieve the evaluation's purpose, the evaluation obtained inputs and evidence from a wide variety of sources, including: A policy and legislative desk-top review to identify legislation and policies that have implications for SRM's current and future mandate and focus (available as a separate report); Seven detailed case studies (with individual case studies relevant to each of the four SRM sub-programmes) to identify lessons to inform SRM's way forward; Detailed key informant interviews with 60 key informant stakeholders (including nineteen current and past SRM officials, six officials from other WCDoA Programmes, and thirty five external stakeholders from various public and private sector organisations), an SRM staff survey(which achieved fifty four SRM staff survey responses (forty eight current (out of fifty one) staff and six past staff) and a review of a wide range of additional documents.

One of the key pieces of legislation which provides the Programme: SRM with its mandate is the Conservation of Agricultural Resources Act 43 1983 (CARA). The purpose of CARA is "To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected

therewith." CARA therefore underpins the centrality of the sustainable use of water, soil and vegetation to the sustainability of the agricultural sector.

Key initiatives which the Programme: SRM is involved in and which possess much potential to positively impact on the above priorities include support for good farming practices which support sustainable use of natural resources (e.g. water resource management and irrigation), participating in area-wide planning and facilitating investments in ecological infrastructure (e.g. soil conservation works, river protection works, fencing, AVC) and on-farm infrastructure (e.g., animal structures and animal waste management). The Programme: SRM plays a vitally important role in enhancing the use of, and access to, both water, vegetation, and healthy soils which provide the key natural resource foundations for sustainable agriculture.

Main findings [1]

SRM: Engineering Services:

This sub-programme plays a vitally important role in irrigation, including facilitating a number of strategic irrigation projects (with Department of Water and Sanitation (DWS) as the primary responsible department) and these hold the potential to have large-scale impacts on increasing agricultural production.

This sub-programme also plays an important role in river rehabilitation and the prevention of agricultural soil erosion and soil loss through designing and implementing innovative river rehabilitation structures. The importance of this service is increasing as the likelihood and severity of floods continues to increase. Ideally, a pro-active and more cost-effective approach is needed to river rehabilitation and based on developing a 3-5 year medium term river rehabilitation strategy and implementation plan. This pro-active approach will require substantial government funding to support pro-active river rehabilitation before flooding disasters take place as well as implementation of a river rehabilitation staff training and capacity building plan to re-focus and re-build internal SRM staff capacity to design river rehabilitation structures.

In addition, there is a need for SRM to ensure that SRM continues to participate in making strategic inputs into various water resource management planning intergovernmental mechanisms and processes. This includes the need to ensure that the Coordinating Committees on Agriculture Water (CCAWs) are functioning effectively (SRM: Engineering coordinates these) and that all relevant stakeholders can contribute towards ensuring that sufficient numbers of small scale farmers are identified and benefit from planned new investments in water augmentation and irrigation infrastructure.

Engineering Services also needs to become more pro-actively involved in testing new technologies and disseminating relevant information to the agricultural sector and which can impact on sustainable natural resource management and agricultural productivity in areas such as small-scale agro-processing and animal waste management (a number of specific technology opportunities are identified in this report).

SRM: LandCare:

Services provided by LandCare have evolved over time. SRM: LandCare and SRM: Engineering both have their origins in the importance placed on soil conservation for sustainable agriculture. LandCare has been involved in a very wide range of projects partly as a result of its approach of focusing on farmer identified local needs. While much

[1] Annexure 2 contains more detailed findings relevant to the gaps, challenges and opportunities facing each of the SRM sub-programmes.

time and effort has been spent on alien vegetation clearing (AVC) due to the large-scale positive impacts that this has on water availability, ecosystem health, and soils, concern has been expressed that too much scare engineering staff time is spent on both coordinating area-wide planning initiatives (which may involve a broader environmental focus beyond the LandCare focus) as well as implementing AVC projects to the detriment of other core LandCare services and skills.

The need exists to ensure that LandCare's scarce engineering capacity is used efficiently and that, wherever possible, the coordination of area-wide initiatives which have a broader focus than LandCare's mandate is undertaken by LandCare staff that has the necessary skills set. In addition, AVC projects should be project managed by project managers (ideally with environmental science backgrounds) and not engineers. In addition, the EPWP job creation monitoring and reporting burden of these projects should be outsourced so as to free up LandCare staff capacity to focus more on core LandCare services such as the provision of advice to farmers, the design of soil erosion and conservation works, and the development of farm management plans.

SRM: LandCare and SRM Land-Use Management can also play an important role in supporting the protection of roductive agricultural land by ensuring that comments on Environmental Impact Applications (EIAs) and CARA applications to develop new land for agricultural purposes include requirements that some land needs to be farmed following relevant CA principles and that restoration plans be put in place where relevant.

SRM: Land-use Management (LUM):

The WC is experiencing growing pressure on agricultural land. The reasons for this include the City of Cape Town's expansion, including eastwards towards the Cape Winelands. In general, the agricultural sector has had to increasingly explore ways of diversifying its income sources to include leisure tourism, conferences and weddings etc. and difficult choices often need to be made regarding what developments can be allowed on agricultural land that will not result in an irreversible loss of agricultural land while also balancing farmer's needs to remain viable and stay in business.

According to the Department Agriculture, Land Reform and Rural Development (DALRRD), the WC SRM: LUM receives the highest number of development applications across all nine Provincial Departments of Agriculture (PDAs) (key informant interview) and current staff capacity is insufficient to effectively comment on all applications received. This can sometimes result in comments submitted after legislated deadlines being disregarded, with further negative implications for the preservation of agricultural land. This sub-programme also lacks capacity to put in place pro-active measures to reduce the volume of applications that are received for comments.

There is a need for SRM Land use management's human resource capacity to be enhanced to ensure that it can respond appropriately (e.g. providing comments within the deadlines and which are detailed, well thought through and not rushed and based on a consultative process as well as able to be defended in court with respect to legal requirements) to the demands being placed on it.

This sub-programme also requires capacity to engage in pre-application consultation processes as well as to initiate pro-active actions (e.g. commenting on Municipal Spatial Development Frameworks, providing guidelines to Municipalities to inform Municipal responses to simpler applications, and developing a Western Cape Agricultural Protection Plan and Policy (WCAPPP)). This sub-programme may also have new

additional demands placed on it in future should the Preservation and Development of Agricultural Land Bill (PDALB) be enacted as this will require the sub-programme to take on new responsibilities and functions.

SRM: Disaster Risk Management (DRM):

Agriculture is one of the sectors most vulnerable to the negative impacts of natural hazards. The FAO has estimated that between 2006 and 2016, "23% of the total damage and loss caused by natural hazard-induced disasters in developing countries, occurred in the agricultural sector"[2]. Agriculture is not only a victim of disasters but is also part of the solution to improving disaster resilience. Parts of the Western Cape have experienced numerous flooding, drought and fire disasters over at least the past twenty years and these have had major negative impacts on the environment, agricultural production, livelihoods and economies.

Over and above providing disaster responses, relief and reconstruction and rehabilitation after disasters occur, it is critical that a range of pro-active disaster mitigation, prevention, and risk assessment, planning and preparedness measures are taken by all stakeholders (and not only government) to minimise the impacts and costs of disasters.

In recognition of the challenges which farmers continued to face, in 2018, this sub-programme introduced provincial bi-annual disaster assessments and these have been widely recognised nationally as a good example of pro-active disaster risk reduction. The disaster assessment process began as a veld assessment and is gradually being expanded in scope to include additional disaster risk assessments

The WCDoA: DM sub-programme needs to expand its human resource capacity and technical expertise in order to take forward a more pro-active approach to disaster preparedness and disaster risk reduction and risk sharing.

Conclusions

It is clear that SRM has the potential to make greater and important contributions to the sustainable management of natural resources, as well as effective support to the agriculture sector, by enhancing its pro-active roles and contributions towards:

1. Promoting healthy agro ecosystems (for e.g. through expanded adoption of CA farming principles and practices;
2. Water resource management (incl. through a strategic approach to AVC, facilitating strategic water augmentation irrigation initiatives (and which include strategic water augmentation initiatives which contribute towards transformation of the agricultural sectors, and strengthening engineering capacity to assist smallholders with small scale irrigation development);
3. Pro-active interventions around land-use management and planning to potentially reduce the work-load on SRM: LUM and to enhance effectiveness in minimising the loss of productive agricultural lands; and
4. Pro-active interventions to reduce the negative impacts on the agricultural sector, as well as opportunities to reduce the costs incurred (both by farmers as well as by government in providing disaster relief) as a result of selected natural disasters.

[2] http://www.fao.org/policy-support/policy-themes/disaster-risk-reduction-agriculture/en/

A theory of change for the improved SRM design has been developed and this clarifies the intended short, medium and long term outcomes that SRM can contribute to, as well as selected assumptions which need to be addressed if SRM's effectiveness is going to be improved.

High level recommendations

Six broad recommendation are made to strengthen the design and effectiveness of the Programme: SRM (refer to the full report for further details):

1. Recommendation 1: Initiative and finalise a Programme: SRM organizational re-design process that strengthen SRM's capacity in core areas and takes into account a range of identified issues.
2. Recommendation 2: Strengthen internal integration and synergies between SRM sub-programmes through a range of measures (refer to the detailed recommendations).
3. Recommendation 3: Strengthen internal integration and synergies between SRM and WCDoA programmes so that SRM's role in supporting farmers, land reform, and agro-processing is strengthened, taking into account specific opportunities and needs (refer to the detailed recommendations).
4. Recommendation 4: WCDoA to develop a Provincial CA Strategy[3] and implementation plan and SRM to strengthen its CA promotion and support role.
5. Recommendation 5: Develop a more focused, transparent and efficient approach to LandCare projects and services.
6. Recommendation 6: Implement a range of additional identified steps to enhance the efficiency and effectiveness of SRM.

[3] The term strategy as used in this evaluation report is defined as "A high-level plan which includes three components (Rumelt, 2011): 1. An assessment and diagnosis of the nature of the situation or problem that is being faced; 2. A general guide giving principles or direction for dealing with the situation; and 3. A set of coherent actions designed to resolve the situation.

1 INTRODUCTION

1.1 Report purpose

The Western Cape Government (WCG): Department of Agriculture (WCDoA) has commissioned Impact Economix to conduct an independent external design and implementation evaluation of the Programme: Sustainable Resource Management (SRM). According to this evaluation's ToR, the purpose of this evaluation is to:

a) Assess the 'Design' and 'Implementation' of the Programme: SRM;

b) Identify internal and external constraints that compromise or limit the ability of the Programme: SRM to effectively deliver on its mandate; including relationships and service demand arrangements with other WCDoA Department structures and programmes (especially Farmer Support and Development (FSD), and private clients; and

c) Propose interventions that could improve the programme's ability to effectively deliver on its mandate.

The purpose of this report is to present the findings, conclusions and recommendations arising from this evaluation so as to inform actions to strengthen the future contribution of the Programme: SRM's contribution towards sustainable agriculture in the Western Cape.

This report should be read in conjunction with the Programme: SRM Policy Literature review report which was developed as part of the evaluation inception phase and which summarises the wide range of policies and legislation which provides a relevant mandate and context for the Programme: SRM.

1.2 Background to the Programme: SRM

The Programme: SRM's main activities are aimed at advising and supporting the agriculture sector's sustainable use of natural resources and improved agricultural productivity and includes technical Engineering and advisory services; LandCare advisory services and projects; Disaster risk management, reduction and preparedness; and Land-use management.

One of the key pieces of legislation which provides the Programme: SRM with its mandate is the Conservation of Agricultural Resources Act 43 1983 (CARA). The purpose of CARA is "To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith." The Act's objective is: "To provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants." CARA therefore underpins the centrality of water, soil and vegetation to sustainability of the agricultural sector.

Key initiatives which the Programme: SRM is involved in and which possess much potential to positively impact on the above priorities include water resource management and irrigation, investments in ecological infrastructure and on-farm infrastructure, the protection of productive agricultural land, and disaster risk reduction and disaster resilience interventions.

Programme: SRM's 2020/21 total budget is R130.621 mil and this is projected to grow to R144.694 mil. in 2022/23. Compensation for employees was R27.6 mil. In 2020/21 and growing by about 10% to R30.5 mil. In 2022/23. Amounts of R21.0 million (2020/21), R29.0 million (2021/22) and R37.0 million (2022/23) has been allocated for various ecological infrastructure investment projects, including AVC in river catchment areas, and amounts of R5.0 million (2020/21), R11.0 million (2021/22) and R15.0 million (2022/23) have been allocated for rehabilitating river banks to control floods, stabilise river banks and to combat erosion.

Programme: SRM has 50 staff of which 20 are based at headquarters at Elsenburg (comprising 12 SRM: Engineering Services staff, 3 LandCare Staff, 2 Land-Use Management Staff and 3 DRM staff- these totals exclude interns) and 30 at various District and local offices (District staff are mainly LandCare staff and also include 4 SRM: Engineering Services staff). The results of the SRM staff survey in sub-section 2.4 below contain a more detailed profile of Programme: SRM staff.

1.3 Methodology and limitations

The evaluation methodology includes seven case studies to identify lessons to inform SRM's way forward (refer to Annexure 1 for the list of case studies). The case studies cover a range of different types of services provided by the various SRM sub-programmes and included case studies that were known to have worked well as well as where challenges were experienced. They are thus a rich source of lessons to inform improvement to future SRM design and/or implementation. The detailed case studies are contained in the evaluation long report.

Data was collected from a wide variety of additional sources, including: 60 key informant stakeholder interviews (including nine SRM officials, six officials from other WCDoA Programmes, and thirty five external stakeholders from various public and private sector organisations), an SRM staff); 54 SRM staff survey responses (48 out of 51 current staff (a response rate of 94%) and 6 past SRM staff) and a wide range of documents (Refer to Annexure 1 for the detailed methodology).

Regarding limitations to this evaluation, the evaluation had limited resources to consult fully with the wide range of role-players relevant to the full range of SRM roles and services. The diversity of SRM's four sub-programmes meant that the available evaluation budget did not make adequate provision to interview more key informants. The budget included provision for 15 key informant interviews and a total of 60 key informant interviews were conducted. This was still insufficient to obtain the diversity of stakeholder perspectives on the different aspects of the Programme: SRM that ideally could have been consulted.

2 Main findings

2.1 SRM staff survey findings

Forty eight out of fifty one SRM staff responded to this evaluation's staff survey (a 94% response rate). Six past SRM staff members no longer employed under SRM also responded. The key findings were as follows:

- Twenty out of forty eight (or 42%) staff respondents are either professional engineers, specialist engineers, or engineering technicians (eleven staff in LandCare and nine staff in SRM: Engineering). Of these 21 staff, twelve have civil engineering qualifications, four mechanical engineering qualifications, three agricultural engineering, and one civil and agricultural engineering qualifications. Nine out of the 20 respondents have

BTech or BEng qualifications. Eight staff have ECSA registration, fifteen do not and only four plan to apply for ECSA registration in future.

- The SRM staff age profile reflects a high proportion of experienced, older staff (Sixty percent of SRM staff responding to the survey are 45 years and older and 34% of staff respondents have 30 or more years of work experience). The last engineer to be employed in SRM was in +-2011.
- On average, across all sub-programmes and including SRM senior management, staff spent 24% of their time on client communication/ advice (incl. attending meetings with other organisations); 24% of their time on project execution and administration; 23% of their time on departmental administration; 9% of their time on research, and 7% of their time on writing reports for external clients. A number of senior staff stated that the time spent on programme administration was detracting from their ability to render an effective service and steps needed to be taken to reduce the administrative burden so that this did not undermine their ability to render an effective services.
- For SRM: LandCare, of the eleven staff that had engineering qualifications: Four staff with civil engineering qualifications had their main work focus as AVC, five staff with civil engineering qualifications had their main focus as rehabilitation of agric. Land (e.g. drainage, protection, veld utilisation, flood repair works, fencing, stock-water systems, farm plans, drainage works), and one staff each stated that their main work focus was LandCare: Area-wide planning initiatives and project management.
- For SRM: Engineering: Two staff with mechanical engineering were focused on agro-processing, two staff with mechanical engineering focused on mechanisation, and four staff focused on water resource management and/or irrigation (three with civil engineering and one with agricultural engineering).
- Eight out of eleven(72%) of LandCare staff respondents who were either professional engineers, specialist engineers, or engineering technicians spend less than 30% of their work time on activities that involve the use of engineering skills.
- In terms of the total number of engineering designs completed by SRM staff in various SRM services in the last year, the eleven engineering staff in LandCare reported completing 104 designs and the nine engineering staff in SRM: Engineering reported completing a total of 170 designs[4]. The two SRM services producing the largest number of designs were SRM: Engineering: Water resource management/ irrigation staff produced about 90 designs and LandCare: Soil conservation works produced about 81 designs. The three engineering services producing the lowest number of designs were Mechanisation (4 designs), Animal Structures (32 designs), and Agro-processing (44 designs).
- The client requesting the largest number of designs was WCDoA: Farmer Support and Development (166 designs or 61% of all designs), followed by requests from external clients (27% of all designs), from within SRM (7% of all designs) and from other WCDoA programmes (5% of all designs).
- Staff reported that on average (across the whole of the Programme: SRM and not at the sub-programme level) the proportion of farmer beneficiary types benefitting from the projects they were working on was 50% commercial farmers, 30% smallholder farmer, and 30% subsistence farmers. At the sub-programme level, SRM: engineering

[4] These numbers must be interpreted with caution as the possibility exists of some double-counting as some staff may have reported designs that they supervised but which were completed by other staff.

and SRM: DRM reported the highest proportion of smallholder farmer beneficiaries at 48% and 40% respectively (35% for LandCare and 5% for SRM: LUM).

- All staff survey respondents primarily involved in Agro-processing (two staff) and LandCare: Area wide planning (one staff) did not feel that their work tasks were making good use of their engineering qualification, while 100% of staff respondents (three staff) doing water resource management irrigation work agreed that their work tasks made good use of their qualification. Staff responses were mixed for: Animal structures (one out of two staff agreed that their work tasks made good use of their engineering qualification; Soil conservation works (three out of five staff disagreed that their work tasks made good use of their engineering qualification) and AVC (two out of four staff felt that this work made good use of their engineering qualification).
- Eight six percent of the 48 staff responses (38 staff) agree (moderately to strongly) that "There are important actions that I could be taking to be more pro-active in addressing sustainable use of natural uses and agriculture but which I am currently not taking" (100% of staff respondents in SRM: DRM (1 staff) and SRM: LUM (3 staff) agreed, 75% (12 out of 16 staff) in SRM: Engineering services and 78% (21 out of 27 staff) in SRM: LandCare moderately to strongly agreed).

2.2 SRM Engineering Services:

As state subsidies to commercial farmers came to an end in the 1990s and early 2000s, there has been a gradual and general reduction (although with some exceptions) in the provision of engineering design support to commercial farmers over the past decade or so.

With respect to water resource management and irrigation, water availability, quality and sustainable use is of central importance to sustainable and productive agricultural production. Currently, an Agriculture Master Plan is in the process of being developed as facilitated by national government and in close cooperation with the WCDoA. The WCDoA: SRM is facilitating a number of strategic irrigation projects (with Department of Water and Sanitation (DWS) as the primary responsible department) and these hold the potential to have large-scale impacts on increasing agricultural production for farmers.

SRM: Engineering also represents the needs of agriculture by participating in and making inputs into various intergovernmental mechanisms dealing with strategic water resource management planning in the Province. The role of SRM: Engineering in identifying blockages and supporting action on the part of DWS to address major water infrastructure maintenance and water supply augmentation initiatives is of critical importance.

There is a need for SRM to ensure that water resource management inter-governmental mechanisms and processes in which it participates in function effectively wherever possible (these mechanisms include the Coordinating Committees on Agriculture Water (CCAWs) and which are coordinated by SRM: Engineering. SRM, together with other responsible stakeholders, need to effectively collaborate to ensure that sufficient numbers of small scale farmers are identified and benefit from planned new investments in water augmentation and irrigation infrastructure. It is important to ensure that the CCAWs roles in submitting recommendations and approving decisions are clear.

There is a critical need to ensure that a SRM: Engineering Services water resource management and irrigation staff succession and skills transfer plan is in place to ensure that SRM builds sufficient skills and capacity to ensure that this work can continue without interruption should and when the current Chief Engineer leave the SRM Programme (either at retirement age or before that).

SRM: Engineering strategic projects, such as Fruitlook, also make an important contribution to supporting agricultural productivity and effective use of water resources. In addition, SRM Engineering play an important role in providing advice to numerous role-players on issues such as irrigation and water resource management planning.

Floods are the most common type of climate-related hazard experienced in the Western Cape (Western Cape Government. 2016). The degradation of rivers has only been serious over the last 40-50 years (partly due to unsustainable agricultural practices such as planting too close to river banks and farmers' obstructing and diverting river flows), and is progressing rapidly and often-times unnoticed. The degradation of rivers impacts immediately and directly on agricultural soil as well as indirectly on dam water storage capacity and water availability (and hence production) due to soil erosion and sedimentation.

Much river rehabilitation work has been reactive in that it has taken place after flood damages have occurred and this has greatly escalated the costs of rehabilitating rivers (as funded by disaster recovery funds). Ideally, a pro-active approach is needed based on developing a 3-5 year medium term river rehabilitation strategy and implementation plan. A pro-active approach will require significant additional government funding from sources other than disaster relief (which by definition can only fund river rehabilitation after a disaster has taken place) if river rehabilitation projects are going to meaningfully address the scale of need. There are likely to be significant positive cost-benefits to implementing pro-active river rehabilitation strategy and implementation plan. A clear SRM river rehabilitation staff skills training and capacity development plan and approach will need to form part of this strategy.

SRM: Engineering also needs to play a more pro-active and active role in testing new technologies that support small scale agro processing (e.g. solar drying and heating technologies), animal waste management, and water-wise agriculture.

2.3 SRM: LandCare

Services provided by LandCare have evolved over time. SRM: LandCare and SRM: Engineering both have their origins in the importance placed on soil conservation and vegetation for sustainable agriculture. This includes the 1983 CARA which remains of primary relevance to the SRM mandate and purpose.

The staff survey carried out for this evaluation shows that LandCare engineering staff mainly focus on either AVC projects or advice and projects focused on the rehabilitation of agricultural land (e.g. drainage, protection, veld utilisation, flood repair works, fencing, stock-water systems, farm plans, drainage works). Two out of the four staff who reported primarily focusing on AVC (a Control technician and a Candidate engineering technician), and three out of five staff who reported primarily focusing on rehabilitation of agricultural land projects (a Control engineering technician and two District managers), did not feel that their work was making good use of their engineering qualification. AVC projects involve a mix of planning, facilitation, coordination, project management and job creation data monitoring and reporting and one additional LandCare staff saw their primary work task as being project management (of area-wide initiatives).

LandCare staff have become involved in a wide range of initiatives, partly due to the subsidies for engineering works coming to an end. As a result, some engineering staff are engaged in stakeholder facilitation and/or project management work (as well as monitoring and reporting of EPWP jobs) which does not necessarily make good use of their engineering skills.

While much time and effort has been spent on AVC due to the large-scale positive impacts that this has on water availability, ecosystem health, and soils, concern has been expressed that too much engineering scarce staff time is spent on both coordinating area-wide planning

initiatives (which may involve a broader environmental focus beyond the LandCare focus) as well as implementing AVC projects to the detriment of other core LandCare services and skills. There is a need to ensure that LandCare continues to focus on its core mandate of promoting vegetation and soil conservation and health (thus contributing to CA) and for LandCare to find ways to efficiently support AVC and area-wide initiatives that focus on promoting health agro-ecosystems (incl. sustainable use of soils, vegetation and water) with staff that have appropriate qualifications and skills.

It is clear that project management skills (ideally combined with environmental science backgrounds) are required for AVC projects. The use of LandCare engineering staff to manage AVC projects represents a misallocation of staff resources with engineering qualifications and experience as project managers are best suited for this function. LandCare's shift from providing engineering work to non-technical work like AVC and stakeholder management of area-wide initiatives has undermined its engineering capacity (skills and experience) and focus on the rehabilitation of agricultural land (incl. the sustainable use of soil, vegetation and water resources). Steps need to be taken to re-build LandCare's engineering skills through more exposure of staff to relevant training as well as facilitating in-house skills transfer opportunities.

The EPWP job creation monitoring and reporting burden of AVC projects should be outsourced so as to free up LandCare staff capacity to focus more on core LandCare services such as the provision of advice to farmers, the design of soil erosion and conservation works, and the development of farm management plans. In addition, the administrative tasks involved in the facilitation and coordination of area-wide planning initiatives driven by LandCare should also be outsourced on the basis of clear Terms of Reference wherever possible to minimise the use of LandCare staff time in carrying out these administrative functions.

Regarding Junior LandCare, the current approach to outsourcing implementation should continue so as to minimise the impact on engineering staff time. In addition, Junior LandCare's core content focus should be refined to include content relevant to promoting awareness of CA and good farming practices (so that Junior LandCare forms a part of the Provincial communication strategy for CA as part of the proposed Provincial agricultural CA Strategy and Implementation Plan).

SRM: LandCare and SRM LUM can should also play an important role in supporting CA by ensuring that comments on Environmental Impact Applications (EIAs) and CARA applications to develop new land for agricultural purposes include requirements (where relevant) that some land needs to be farmed following relevant CA principles and that restoration plans be put in place. There may be a need for LandCare to diversify its staff skills set beyond engineering skills and add to the existing skills set a new occupational class (e.g. BSc Natural Science) to strengthen its role in promoting CA and good farming practices. For example, LandCare's development of Farm Management Plans need to not only include soil conservation works, but broader CA good farming practices and provisions (it is also possible that WCDoA: FSD should make inputs on CA good farming practices).

There is no formal Western Cape LandCare strategy and implementation plan to guide what support is provided by LandCare (over and above broad national guidelines) to what types of beneficiaries and what processes are followed to decide on LandCare priorities and to provide such support. The 2018 evaluation of LandCare found that LandCare did not follow a programmatic approach and instead followed an "adaptive management" approach which responded to various needs which were identified through various relationships between LandCare officials on the ground and the various internal and external stakeholders. One of the 2018 evaluation recommendations was that "Applying a clearer programmatic design to

LandCare will support a more transparent, if not entirely systematic, prioritisation of spatial areas for LandCare's intervention. WCDoA should define the criteria for prioritising the spaces in which LandCare seeks to drive sustainable natural resource management within an adaptive management approach".

2.4 SRM Land-use Management:

An ongoing concern is the subdivision and loss of agricultural land due to change of land uses e.g. mining, industrial/residential developments.

The Western Cape is experiencing growing pressure on agricultural land as the City of Cape Town expands eastwards towards the Winelands (thus placing pressure on Cape Town's urban edge as defined in its Spatial Development Framework) and as the wine sector continues to face challenging economic circumstances (resulting in farmers looking for diversifying their income streams- for example from tourism activities, as well as residential developments on farms, and the sale of farms to lifestyle farmers (where the purchasers of farms have a primary occupation other than farming). Difficult choices often need to be made regarding what developments can be allowed on agricultural land that will not result in an irreversible loss of agricultural land while also balancing farmer's needs to remain viable and stay in business.

According to DALRRD, the WC SRM: LUM sub-programme receives the highest number of development applications across all nine PDAs (key informant interview). There is a range of legislation which applies to different types of land-use applications, re-zonings, and/or departures. These include NEMA (for Environmental Impact Assessments and where DEA&DP is the mandated decision-making authority), SPLUMA (where Municipalities are the mandated decision-making authority), and the Subdivision of Agricultural Land Act 70 (where the National DALRRD is the decision-making authority). As a result, there is an ongoing need for coordinated interaction between DALRRD, Municipalities, DEA&DP, and SRM to ensure all relevant legislation informs SRM's comments and that these are legally defensible.

The SRM Land-use management sub-programme has to deal with a wide range of issues and internal and external challenges which continuously threaten to accelerate the loss of productive agricultural land in the Western Cape. These include the large volume and complexity of applications which the one LUM manager needs to review, conduct site visits, coordinate with decision-makers on, and respond to within legislated deadlines.

Three land-use management case studies were conducted and key lessons identified from these case studies. These case studies show that SRM: Land-use management does not have sufficient capacity to always comply with the legislated time-frames for commenting on different types of applications in terms of the various applicable legislation. This can result in comments submitted after such deadlines being disregarded, with further negative implications for the preservation of agricultural land.

In addition, SRM LUM does not always have sufficient capacity to engage in pre-consultation meetings, to conduct the required site visits across the whole Province (these form a critical part of being able to comment effectively on applications), or to coordinate responses to applications by meeting with relevant Municipal and/or Provincial officials to allow for all relevant Considerations to inform SRM: LUM comments.

This sub-programme may also have new additional demands placed on it in future should the Preservation and Development of Agricultural Land Bill (PDALB) be enacted as this will require the sub-programme to take on new responsibilities and functions. There are a wide range of proposals contained in the PDALB that could have important implications for the SRM: LUM function and logistical demands placed on it, as well as for its future human resource staffing requirements.

Given the political interference sometimes takes place in development application commenting processes, as well as the fact the Municipalities do not always appreciate how certain decisions may establish a precedent which has a broader negative knock-on effect on future Municipal decision-making affecting agricultural land, it is critical that agricultural policies exist wherever possible to guide decision-making and minimise the potential for political decisions to be taken on the basis of short term interests that may negatively impact on the future availability of productive land for agricultural purposes and hence on future food production and food security.

There is a need for SRM: LUM's capacity to be enhanced to ensure that it:

1. Can respond appropriately (e.g. providing comments within the deadlines and which are detailed, well thought through and not rushed and based on a consultative process as well as able to be defended in court with respect to legal requirements, relevance, accuracy and other subject matter detail) to the demands being placed on it; and
2. Can Initiate a range of pro-active actions that have the potential to reduce the volume of applications to comment on (e.g. Provide comments on draft Municipal Spatial Development Frameworks; Provide Municipalities with guidance on simpler types of applications such as departures so that Municipalities do not refer these to SRM for comment).

The risk exists that SRM's objections to development applications that will result in the significant loss of high potential and or valuable agriculture land will either be over-ridden at national, provincial and/or municipal levels as a result of political interference and/or will be sub ordinated to other criteria. The possibility of SRM: LUM (together with DEA&DP) developing a Western Cape Agricultural Protection Plan and Policy (WCAPPP) has been raised to address this.

2.5 SRM: Disaster Risk Management (SRM: DRM)

The 2015 Sendai Framework for Disaster Risk Reduction (SFDRR), the South African Disaster Management Act of 2002, and the Western Cape Disaster Management Framework (2010) all provide relevant context and mandate for the WC: DRM sub-programme.

Agriculture is one of the sectors most vulnerable to the negative impacts of natural hazards. The FAO has estimated that between 2006 and 2016, "23% of the total damage and loss caused by natural hazard-induced disasters in developing countries, occurred in the agricultural sector"[5]. Agriculture is not only a victim of disasters but is also part of the solution to improving disaster resilience. Farmers are direct custodians of the environment and the way they manage natural resources can prevent natural hazards from becoming crises. Ecosystem services contributed to by farmers (e.g. long-term soil fertility, the regulation of water quality, carbon sequestration, and support for biodiversity and cultural services) should be acknowledged, costed and translated into tangible returns for them wherever feasible.

It is useful to summarise the disaster continuum and various phases of disaster risk management as follows: Disaster reduction phases (incl. disaster mitigation, prevention and/or preparedness before a disaster occurs) and disaster recovery phases after disasters begin occurring (incl. disaster relief, disaster rehabilitation, and disaster reconstruction).

Over and above providing disaster responses, relief and reconstruction and rehabilitation after disasters occur, it is critical that a range of pro-active disaster mitigation, prevention, and risk

[5] http://www.fao.org/policy-support/policy-themes/disaster-risk-reduction-agriculture/en/

assessment, planning and preparedness measures are taken by all stakeholders (and not only government) to minimise the impacts and costs of disasters.

Parts of the Western Cape have experienced a number of disasters in recent years, These include the 2009-2011 drought which impacted primarily on the Central Karoo and Southern Cape (as well as in 2015-2020), various flooding incidents (which include the famous 1981 Laingsburg flash-flood and various flood events in 2003, 2008, 2011-2014 and which negatively impacted on river structures and erosion and the loss of productive agricultural land, as well as destroyed dams needed for water storage and irrigation), and extensive hail damage in 2014 and 2019 (affecting fruit producers in Drakenstein and Bergrivier Municipalities).

In terms of drought, between 2009 and 2011 a drought hit the Central Karoo and Southern Cape regions. At the time, there was not systematic drought risk management planning and this resulted in the late detection of the drought as well a delayed and very costly drought response (Western Cape Government. 2016).

In recognition of the challenges which farmers continued to face, in 2018, the department introduced provincial bi-annual disaster assessments. These assessments are conducted by a disaster risk management team, which consists of representatives from the WCDoA, Provincial Disaster Management Centre (PDMC), DALRRD and National Disaster Management Centre (NDMC).

SRM: DRM has been successful in using this disaster assessment process to provide drought support in the form of fodder vouchers. This has included developing a baseline for droughts and other natural disasters in the province. The disaster assessment process has potential to be expanded in scope to include a range of additional disaster risk assessments, including river, fire, and soil health assessments (amongst other potential hazards).

At a national level, DALRRD has undertaken a study on Provincial Disaster Risk Management capacity. Once the study is finalised, DALRRD intends to approach National Treasury to obtain funding to strengthen disaster management capacity in the Provinces (Key informant interview). DALRRD would like to see PDAs devoting more priority, focus and capacity on disaster risk reduction initiatives.

The WCDoA: DRM sub-programme needs to take forward a more pro-active approach to disaster preparedness and disaster risk reduction and risk sharing. Some of the key pro-active mitigation actions that SRM can play a central role in implementing to reduce the potential negative impacts of disasters include undertaking hazard mitigation planning and studies for a broader set of disaster risks, including flooding and soil health.

The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. Mitigation is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. Mitigation policies and actions are identified by an assessment of hazards, vulnerabilities and risks, and include the participation of a wide range of stakeholders and the public in the planning process.

The SRM: DRM sub-programme need to ensure that disaster mitigation planning and risk assessment, preparation and reduction initiatives are taken forward in all the Province's Districts for key hazards relevant to the agriculture sector and that it is able to coordinate access to post disaster support at the District level.

2.6 Fourth Industrial Revolution Opportunities

The WCDoA's 2018 Fourth Industrial Evaluation "The future of the Western Cape agricultural sector in the context of the Fourth Industrial Revolution" identified a number of opportunities

and recommendations to support the competitiveness, growth and sustainability of the Western Cape Agriculture sector. This SRM evaluation was tasked with identifying which findings and recommendations from this evaluation should be considered in improving the design, efficiency and effectiveness of the Programme: SRM?

The 4th IR identified smart water technologies as a promising area for greater adoption. This includes solar power for irrigation as well as smart monitoring of water use. The SRM: Engineering Fruitlook initiative, amongst others, has shown that new digital data sources (which includes earth observation data from satellites as well as drones as well as in-situ sensors (e.g. in rivers)) provide tremendous opportunities for enhancing approaches to supporting sustainable agriculture.

The main 4th IR evaluation recommendations that have relevance to the Programme: SRM are as follows:

Table 1 Fourth Industrial Revolution Evaluation Recommendations applicable to Programme: SRM

4th IR Recommendation Area	**Recommendations applicable to Programme: SRM**	**SRM Evaluation comments**
Recommendation 3: **Accelerate technology adoption in agriculture**	3.1 With suppliers and scientists, the WCDOA and producers should aggregate and disseminate Information In a transparent open- source and equitable basis through various agrl-forums. The write-up of successful case studies should be encouraged and incentlvlsed.	Case studies can be a useful tool to accelerate technology adoption as well as climate smart agricultural practices/ precision agriculture/ CA and other pro-active practices that farmers can take to mitigate and adapt to climate change and disasters. SRM: Engineering: There may be key technologies where they can play a demonstration role (e.g. solar, agri processing etc.)
	3.2 The WCDoA should lead Initiatives for expanding and Improving current databases. Important agricultural data should become part of a shared Information platform that facilitates the collation and use of Information in the sector (OEM data to be publicly available).	The potential for improving data on different types of disaster risks (incl. soil health) could be explored as part of SRM: DRM's recommended risk vulnerability assessment processes. Supporting CA by working with FSD to provide smallholder farmers with tools to measure their carbon footprint calculator using mobile phone applications and a cloud-based system. This can support future carbon sequestration initiatives which are likely to become more widespread in future.

4th IR Recommendation Area	**Recommendations applicable to Programme: SRM**	**SRM Evaluation comments**
	3.4 The department should coordinate the creation of capacity to develop business cases for investing in technology. This requires independent, verifiable information on return on investment and associated benefits and productivity improvements. This should be independently determined and made public for practitioners to use in the development of their investment business cases.	SRM: Engineering can play a role in clarifying business cases for certain types of technology, including renewable energy technologies such as solar thermal plants (for fruit and vegetable agro-processing solar drying), solar technologies for irrigation and pumping systems (especially relevant for smallholder farmers) etc.
	3.6 All role players In the value chain can supply extension services and be able to demonstrate technologies and communicate their benefits, proper application and system requirements equitably.	SRM: Engineering can make available better information on renewable energy technologies, animal waste technologies, and water use monitoring metres (possibly via WCDoA: FSD extension officers).
Recommendation 4: **Smallholder commercial farming development**	4.7 Smallholder farmers should explore high-value niche market products to be cultivated in smaller quantities. There is also the opportunity to define and supply specific local markets and communities with home-grown commodities	SRM: Engineering can play a role in clarifying business cases for certain types of technology, including renewable energy technologies such as solar thermal plants (for fruit and vegetable agro-processing solar drying), solar technologies for irrigation and pumping systems etc.

Additional Key identified opportunities include the following:

Table 2 Additional Fourth Industrial Revolution opportunities for Programme: SRM to explore further

Programme: SRM sub-programme	**Potential opportunities**
Disaster Reduction Management	• Improved access to early warning weather information: "There are online weather services that focus exclusively on agriculture, and farmers can access these services on dedicated on board and handheld farm technology but also via mobile apps that run on just about any consumer smartphone. This technology can give farmers enough advanced notice of frost, hail and other weather that they

Programme: SRM sub-programme	Potential opportunities
	can take precautions to protect the crops or at least mitigate losses to a significant degree." (Sheela and Chakravarthi. 2019). • Remote internet enabled cameras could be used to remotely monitor the condition of infrastructure built with disaster relief funding (e.g. river structures) as well as to provide early warnings of potential future disasters (e.g. remote cameras to detect flooding or fire events). • Cost-effective Technologies to monitor relevant disaster risks (incl. Soil health beyond measuring soil nutrition, as well as soil moisture) (and provide early warning for droughts). There are different kinds of on-the-go soil sensors which can indicate different agronomic soil properties (see Adamchuk and Viscarra Rossel. 2014). • Mobile phone applications to facilitate the submission of data (forms, photographs) from site visits to the field (e.g. SRM: LUM; SRM: DRM disaster assessments; disaster relief supported farmers submitting information on the use of disaster funds etc.). • Predictive analytics to analyse large data sets and provide forecasts or warnings for potential future disasters such as floods. • Use of drones for mapping the impacts of disasters in real-time as well as for post-disaster damage assessments as well as for creating 3D maps to model disaster areas[6].
Engineering	• Drones for pro-active assessment of river rehabilitation needs in hard to access areas and/or for monitoring use of infrastructure. • Precision agriculture technologies to improve irrigation system efficiencies as well as other water conservation technologies (e.g. for waste management, agro processing etc.). • 3D printing technologies could be used for proto-typing farm implements as part of mechanisation support (e.g. CA implements). • Solar-powered drying technologies for small scale fruit and vegetable agro processing.[7] • Mobile phone application technology for the improvement of communication between SRM: Engineering and FSD that will result in better service to clients in the agricultural sector (an SRM: Engineering Services staff member has developed a prototype app for further testing).

[6] See for example: https://indd.adobe.com/view/d982d945-dab4-40f7-8aaf-d8fc96d586cb
[7] See for example: https://www.aee-intec.at/0uploads/dateien553.pdf and https://www.researchgate.net/publication/309304133_A_Review_on_Solar_Drying_of_Agricultural_Produce

Programme: SRM sub-programme	Potential opportunities
LandCare	• Drones to collect aerial images to assist with informing SRM: LUM application / EIA commenting processes (esp. where sites are remote and inaccessible) as well as to monitor AVC projects. • Shared equipment IT-enabled models could be used for shared access to farm equipment (e.g. specialised CA farm equipment)[8].
Land-use management	• Drones to collect aerial images to assist with informing SRM: LUM application / EIA commenting processes (esp. where sites are remote and inaccessible). • Mobile phone applications to facilitate the submission of data (forms, photographs) from site visits to the field (e.g. SRM: Land use management; SRM: DRM veld assessments and other hazard assessments; disaster relief supported farmers submitting information on the use of disaster funds etc.).

3 Conclusions and Theory of Change for improved Programme: SRM

3.1 Conclusions

It is clear that SRM has the potential to make greater and important contributions towards promoting at least the following:

- Soil conservation and healthy agro-ecosystems: This includes LandCare's role in providing advisory services to farmers on soil conservation as well as LandCare's development of Farm Plans containing soil conservation and CA measures as well as SRM's development and implementation of a River Rehabilitation Strategy and Implementation Plan. In addition, the potential for Programme SRM and Programme FSD to work jointly to implement CA pilot projects in all Districts of the Province should be further explored.
- Sustainable water use through a strategic approach to prioritising AVC initiatives and ensuring that project managers are used to manage AVC, facilitating strategic water augmentation irrigation initiatives (and which include enhanced access to water for smallholders), and strengthening engineering capacity to assist smallholders with small scale irrigation development.
- Additional pro-active interventions (as identified previously in sub-section 2.4) around land-use management and planning to minimise the work-load demands on the SRM: LUM sub-programme and enhance the Province's effectiveness in minimising the loss of productive agricultural lands.

[8] For an example of equipment sharing models see, for example: https://projects.sare.org/sare_project/fne16-844/

- Pro-active interventions to reduce the negative impacts on the agricultural sector, as well as the direct costs to both farmers and government, in recovering from disasters, of natural disasters through greater disaster risk assessment, preparation and mitigation planning for a range of natural disasters over and above droughts (e.g. floods).

The WCDoA as a whole needs to explore and define a more pro-active role in advancing the adoption of CA across the Province and in contributing to Provincial targets for the proportion of agricultural grazing and crop lands in the WC that are benefitting from CA good farming practices.

Efforts need to be made to reverse the loss of engineering focus, capacity, skills and experience in both SRM: Engineering and SRM: LandCare so that this support can continue to be responsive to the engineering needs of internal and external clients. Given the scarcity of SRM engineering skills and staff, it is important that scarce engineering skills/ staff are not involved in project managing AVC projects and that greater attention can be paid to enhancing SRM's role in promoting the objective of CARA, namely to "To provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants."

A constraint which could undermine SRM's capacity to provide support to other WCDoA programmes is the lack of formal referral decision-making processes to respond to internal or external requests for support. While this promotes flexibility, there is a need for a clear prioritisation approach with respect to how SRM decides to allocate its scarce staff resources and to ensure that staff are focusing their time on clearly identified SRM priorities wherever possible. Developing a formal LandCare strategy and implementation plan should contribute towards achieving greater clarity on priority focus areas and prioritisation of support to relevant initiatives.

SRM staff engineering qualifications, skills and experience have the potential to make important contributions towards SRM's mandate. However, there is a need to ensure that SRM engineering staff are able to constantly improve their technical skills and practical project experience and ideally meet the requirements of registering with ECSA if they are going to be in a position to support these priorities, as well as enhance their role in pro-actively supporting a pro-active approach to disaster risk reduction through the development and implementation of the river rehabilitation strategy and implementation plan.

It is important that SRM move to a more pro-active and focused approach than has previously been the case. This includes the need to enhance linkages internally between SRM sub-programmes as well as externally with other WCDoA programmes.

There is also a need for SRM to place more emphasis on both increasing its human capacity in key areas as well as aligning and resourcing ongoing professional development of existing staff with priority focus areas moving forward.

3.2 Theory of Change for a more effective Programme: SRM

A theory of change for the improved SRM design has been developed and this clarifies the intended short, medium and long term outcomes that SRM can contribute to, as well as selected assumptions which need to be addressed if SRM's effectiveness is going to be improved.

Theories of Change are ideally developed based on a root-cause analysis of problems, challenges and opportunities that programmes chooses to focus on. The problems and

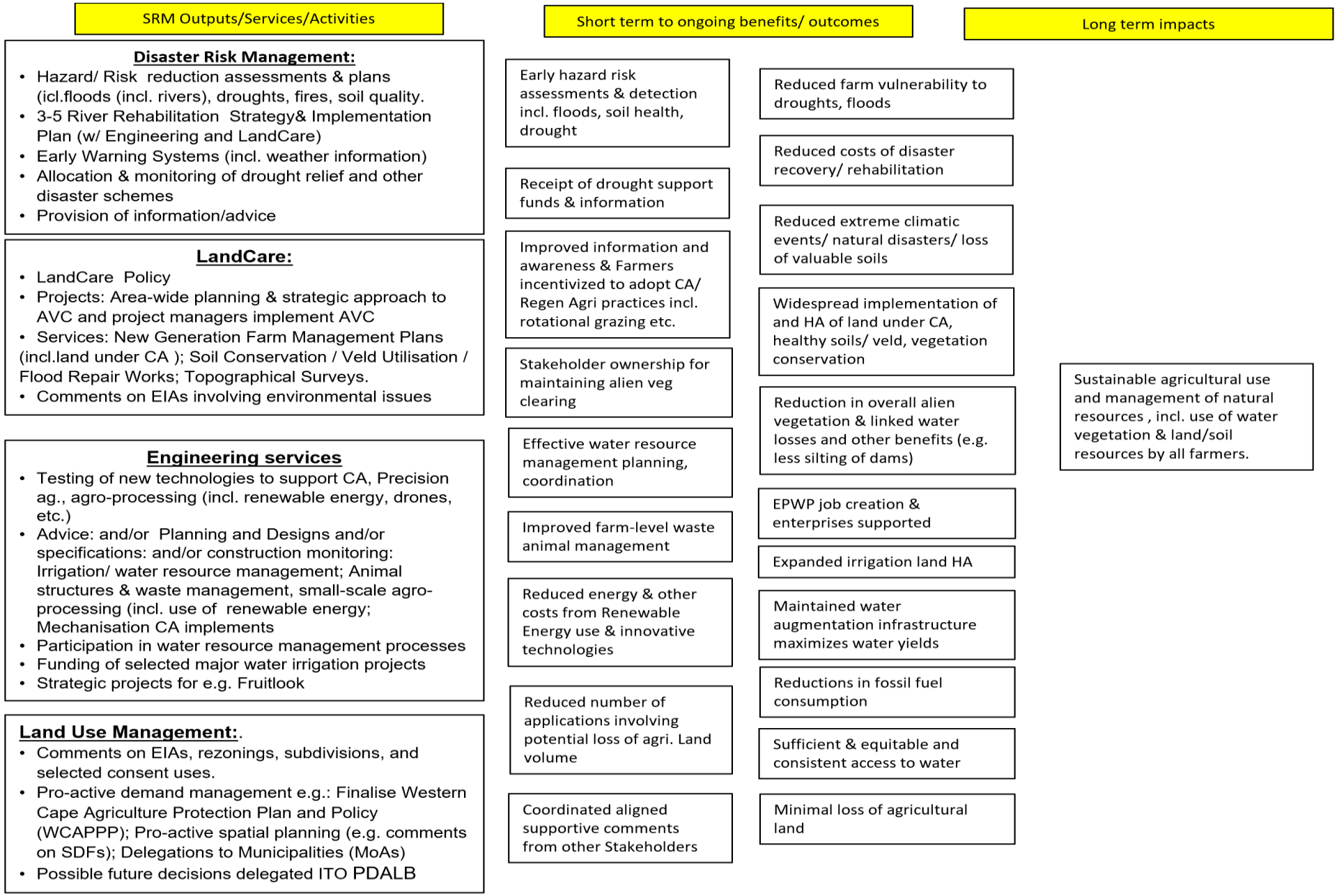
challenges which the Programme: SRM plays a role in addressing are both numerous and complex and it is beyond the scope of this report to analyse the root causes of all of these.

Selected causes which lie behind constrained natural resources for agriculture include the following:

- The ecosystem costs of producing food are not fully factored into food prices. Farmers also see their primary role as running profitable businesses and not necessarily as implementing farming practices which contribute towards long-run soil health, broader ecosystem health, and reducing climate change. As a result, certain farming practices undermine long term soil health through various farming practices including over-use of fertilisers and pesticides, unnecessary soil disturbance, lack of ground cover etc. and do not optimise the use of water.
- Government policy and support programmes have not sufficiently incentivised farmers to adopt CA good farming practices. In addition, farmer's understanding, awareness of and attitudes towards these farming practices may be constrained by available relevant information and this may constrain wider adoption of sustainable agricultural practices.
- Increased competition for, and limited, water supply (caused by many factors - many of which do not fall under SRM's mandate- including lack of pro-active planning for new water storage, water wastage; unlawful water usage; groundwater contamination/salinity; poor enforcement of regulations for water pollution, climate change and droughts and reduced yields in water catchments, inefficient water storage, lack of diversification of water sources; increased competition for allocations of water both between farmers and between agriculture and domestic and industry users; insufficient monitoring of agricultural water use), as well as temperature increases and changing precipitation patterns (which are in turn linked to poor soil management practices), droughts and increases in natural disasters
- Loss of existing land available for expansion of agriculture (causes include poor adherence to land-use management legislation and Provincial policies; lack of enforcement of regulations/ EIAs / SDFs/ zoning schemes; political interference and/or corruption).
- Declines in productivity of existing agricultural (causes include land degradation from over-use of fertilizer and other chemicals (which can contaminate water), over grazing and erosion; natural disasters such as droughts, fires and floods.

The ToC which is aimed at addressing some of these selected causes is contained in Figure 1 (note that the causal arrows between Programme: SRM services/ outputs and the various short, medium and long-term outcomes are too numerous to include in this summary diagram).

Figure 1 Theory of Change Summary for more effective Programme: SRM



There are a wide range of assumptions and risks which lie behind the successful implementation and effectiveness of this ToC and SRM management will need to pay attention to these moving forward. These include:

1. Assumptions important to ensuring that the delivered SRM outputs address some of the core causes of unsustainable natural resource use.
2. Assumptions which lie behind how SRM Inputs/ Resources are used to ensure delivery of intended outputs/ services.
3. Assumptions important to ensuring that the delivered SRM outputs achieve the intended short-term and medium outcomes.

Assumptions important to ensuring that the delivered SRM outputs address some of the core causes of unsustainable natural resource use:

Disaster Risk Management	a) Access to disaster support is conditional on adherence to Farm Management Plans and such plans extend beyond animal carrying capacity and soil/veld conservation structures and include selected good farming practices aligned with CA.
LandCare	a) Farm Management Plans are strengthened and such plans extend beyond animal carrying capacity and include selected good farming practices aligned with CA. b) The proposed Western Cape LandCare Strategy and Implementation Olan makes access to LandCare support conditional on adherence to good farming practices which promote CA where feasible. c) Conservation Committees operate effectively in terms of appropriate representativity, participation and clear decision-making authority,
Engineering	a) Water resource and allocation governance structures operate effectively in terms of appropriate representativity, participation and clear decision-making authority. b) Programme: SRM participation in water resource management planning processes with DWS will result in national resources being allocated to both maintenance of existing water irrigation infrastructure and new/ expanded irrigation infrastructure. c) Programme: SRM Staff capacity exists to play a greater role in improving the monitoring of on-farm water usage through ensuring water metres are comprehensively implemented on all relevant farms.
Land use management	a) Programme: SRM staff capacity exists to develop a WCAPPP and the inter-governmental legal framework makes provision for this. b) The WCAPPP minimises the scope for political interference in WCDoA comments on EIAs, subdivisions, re-zonings and consent uses involving agricultural land.

Assumptions which lie behind how SRM Inputs/ Resources are used to ensure delivery of intended outputs/ services

Disaster Risk Management	a) Sufficient staff capacity exists to conduct research and develop methodologies and processes to conduct pro-active risk assessments and ongoing monitoring of risks for floods, soil health, droughts, fires etc. b) SRM: Engineering and SRM LandCare will provided needed support for river rehabilitation and facilitating access to and monitoring use of disaster relief.
LandCare	a) Scarce engineering capacity is not used to project manage alien clearing projects (instead project managers are used). b) AVC projects are managed efficiently. c) LandCare staff have skills relevant to promoting CA good farming practices beyond soil/ veld conservation works. d) Either an existing staff member, or new staff member, is appointed with SRM to coordinate and drive a stronger focus in all sub-programmes on promoting CA.
Engineering	Staff can be pro-active and take initiative to test new technologies and disseminate relevant information effectively to support sustainable agriculture.
Land use management	Human resource capacity is expanded in order to implement pro-active measures to reduce the commenting work-load.

Assumptions important to ensuring that the delivered SRM outputs achieve the intended short-term and medium outcomes

Disaster Risk Management	a) Farming practices are increasingly pro-active and aligned to CA and thus farms are less susceptible to the negative impacts of droughts and floods.
LandCare	b) New Age Farm Plans are able to be used effectively to promote wider adoption of CA good farming practices,
Engineering	c) Emerging farmers increasingly have sufficient access to water and appropriate irrigation and other cost-effective technologies.

Possible Programme: SRM outcome indicators linked to the extent to which selected intended Programme: SRM outcomes are achieved or not and which the Programme: SRM could consider for future monitoring include the following: ; Size (HA) of agricultural Land lost to agricultural production as a result of land development/ land-use changes; Change in size of agricultural land under irrigation (as well as change in the size of land under irrigation for smallholder farmers).

3.3 Recommendations

Recommendation 1: Initiate and finalise a Programme: SRM organizational re-design process that strengthens SRM's capacity in core areas and takes into account at least the following:

a) Creation of a chief-director post for SRM to bring it in line with other WCDoA Programmes.

b) Creation of director posts below the chief director post. One option in this regard would be to create a Director post for SRM: Engineering and SRM: DRM and a Director post for SRM: LandCare and SRM: LUM. This will assist with enhancing collaboration across sub-programmes. There may also be a need to refine relevant occupational classes to reflect existing job responsibilities relevant to providing support and collaboration across sub-programmes.

c) For SRM: DRM: Additional professional capacity is needed for at least the following broad phases of DRM: 1. Disaster mitigation and contingency planning; 2. Disaster preparedness and risk assessment; 3. Post disaster support: rehabilitation and recovery. In addition, there is a need for district capacity with a different skills set / occupational class that can assist with post disaster support as well as disaster preparedness and risk assessments. These coordinators could potentially be identified from and filled by existing LandCare staff working at the District level. This District capacity must be confirmed after a work study exercise.

d) For SRM: LUM: Appoint additional professional staff capacity to support the Land-Use Manager and who has relevant practical experience and knowledge of applicable legislation as well as knowledge of agricultural science and environmental management.

e) For SRM: Engineering: Ensure that staff with appropriate irrigation/ water resource management skills exist below the Chief Engineer in order to implement a documented staff succession and skills transfer plan with respect to the water resource management role of SRM. This may require shifting existing staff with irrigation experience from SRM: Engineering: Animal Structures.

f) For SRM: Engineering/ LandCare: Strengthen capacity for supporting agro ecosystems incl. soil conservation works and CA. This may include broadening the skills base and supporting existing staff enhance their soil conservation and CA knowledge and expertise. There may also be a need to identify options to achieve more seniority in engineering staff located at District field to allow for quicker decision-making.

g) Specialist posts need to be created that support career paths and skills retention for engineering professionals that do either not desire management positions and/or do not qualify due to the application of employment equity targets given the general scarcity of engineering skills as well as the challenges faced by the Programme: SRM over the past few years to attract new staff with engineering skills.

h) Assign responsibility for coordinating the proposed Provincial CA Strategy and Implementation Plan to either an existing SRM staff member or explore the creation of a new post.

i) Consider the possibility of creating new posts that require skills necessary to support the increasing importance of, and emphasis on, CA as well as other ecosystems approaches (e.g. environmental officer personnel with environmental qualifications to address environmental issues and advance soil health and soil organic carbon levels across the Province). This includes consideration for the creation and filling of natural scientist post within SRM to boost SRM's capacity in various sub-programmes e.g.: SRM Land Use Management (commenting on agricultural potential studies); SRM: DRM's soil health assessments and monitoring; SRM LandCare's new generation Farm Management Plans to address CA good farming practices etc.

j) The job descriptions for technical specialists should include that a certain percentage of their time must be spent on staff training and mentoring.

k) Consideration for the promotion of technicians to the Control Technician's post/ salary level after technicians reach their highest salary notch (subject to a job evaluation).

l) Job evaluations should also be conducted of relevant existing and potential new posts (especially SRM management level posts) in order to inform current and new job post level determinations, including any possible changes to post levels. The SRM: Director should receive proposals from the four SRM sub-programme managers regarding which existing and potential new posts should be job evaluated.

Recommendation 2: Strengthen internal integration and synergies between SRM sub-programmes, taking into account at least the following:

a) SRM: Engineering and SRM: LandCare

- LandCare to develop a river rehabilitation strategy and implementation plan including a clear approach to identifying and prioritising pro-active river rehabilitation hot-spots and a staff training plan to re-build in-house capacity to design river rehabilitation structures.
- The roles of both sub-programmes as well as SRM: DRM in promoting and supporting farming practices which advance CA need to be clarified.

b) SRM: Land-use Management and LandCare: Clarify and agree LandCare's role in commenting on certain types of EIAs and integrate this responsibility into relevant job descriptions for LandCare staff based in the District offices.

c) SRM: DRM and LandCare: Ensure sufficient staff capacity is in place to deal with expected increases in natural disasters and the need for disaster risk assessments, preparation, mitigation and post-disaster support at the District level.

d) SRM: DRM, SRM: Engineering, and SRM: LandCare: SRM: DRM to coordinate the development of a 3-5 year River Rehabilitation Strategy and Implementation Plan. In addition, SRM: DRM to develop hazard mitigation plans for at least flooding, drought, and soil quality hazard. These should be developed by SRM: DRM in collaboration with SRM: Engineering and SRM: LandCare, as well as other relevant role-players.

e) Opportunities to develop and utilise additional smartphone technologies that capacitate WCDoA FSD and internal SRM sub-programmes to improve sharing and transfer of information (refer to Table 2).

f) Where joint initiatives are required between SRM sub-programmes (as well as other WCDoA programmes) (refer to examples highlighted in Recommendations 2 and 3) opportunities for officials from SRM sub-programmes to engage in joint rapid appraisal and planning participatory processes should be explored to adequately build on and incorporate the knowledge, experience and perspectives of each sub-programme and WCDoA Programmes. Where feasible, local stakeholders should be included in these rapid planning participatory processes to ensure that local needs and knowledge informs a holistic analysis of challenges and opportunities (and their causes) and proposed solutions (including support services).

Recommendation 3: Strengthen internal integration and synergies between SRM and WCDoA programmes so that SRM's role in supporting smallholder farmers, land reform and agro-processing is strengthened, taking into account at least the following:

a) Linkages between LC and WCDoA: Rural Development need to be strengthened so that vulnerable rural communities can benefit more by participating in LC projects.

b) Linkages between SRM Engineering and WCDoA: Agricultural Economics in supporting the Agri BEE agro-processing fund initiatives.

c) Linkages between SRM: Engineering and WCDoA: FSD to ensure that FSD funding applications are viable and feasible from an engineering perspective.

d) Linkages between SRM: Engineering and WCDoA: FSD and WCDoA: Rural development to clarify WCDoA's approach and programme roles with respect to enhancing access to water for farmers in the Province (including how opportunities from strategic water irrigation projects being facilitated by WCDoA can provide such access if successfully implemented).

e) SRM: Land-Use Management and WCDoA: Agricultural Economics Programme: Collaborative research on agriculture feasibility to inform the development of minimum farm sizes as informed by identifying minimum farm incomes required for different commodities in different climactic regions in the Western Cape.

f) SRM: DRM and WCDoA: Agricultural Economics Programme to conduct economic impact studies on key disasters affecting agriculture.

g) The development of formal SRM support request referral processes which may involve clarifying relevant criteria to be used when assessing requests for support so that scarce resources can be focused on clearly defined SRM priorities wherever possible. Care must be taken however, that these referral processes are not overly bureaucratic and inefficient with respect to the speed of decision-making and responses to support requests.

Recommendation 4: The WCDoA to develop a Provincial Conservation Agriculture Strategy and Implementation Plan to inform a well-resourced and integrated support approach to expanding the implementation of CA the Western Cape:

The DAFF May 2019 draft policy on CA proposes the establishment of a National CA Forum to bring together key stakeholders important to taking forward the implementation of the national CA policy. The draft policy establishes an ambitious goal of ensuring 50% of agricultural land under cultivation is applying CA in some way. The Western Cape needs to develop its own targets for the proportion of land under grazing as well as crops that is applying aspects of CA and/or Regenerative Agriculture.

The WCDoA needs to formulate a Provincial CA Strategy and Implementation Plan (as informed by, and to support implementation of, the national policy) on CA. This will need to involve clarifying the roles and contributions to be made by the WCDoA and its various programmes, including SRM, as well as other stakeholders.

It is recommended that a Provincial CA Strategy Coordinating Committee be established to coordinate the development of this Western Cape CA Strategy (unless an appropriate existing structure already exists that can serve this role) and that this process begin with drafting a Terms of Reference to inform the drafting of the Western Cape CA Strategy. Private sector representatives should be included on this Committee. This policy should address various aspects, including:

- Clarity on institutional governance arrangements including the role of and representation on Conservation Committees and clarity on WCDoA participation in these and other relevant structures.
- Development of WCDoA incentives that it has under its control and which can influence and encourage farmers to increasingly adopt CA good farming practices. These incentives could include refinements to the eligibility/ qualification criteria that farmers need to meet in order to obtain access to various WCDoA support (e.g. AVC, Engineering structures, disaster management support, CASP, comments on EIAs, CARA applications and other development applications etc.) so that, where possible, such support is linked to increased adoption and implementation of CA/ Regenerative Agriculture farming practices.
- Ideally issues related to, and proposals for, improving the monitoring of soil health in the Western Cape.
- The scope to improve CA support to farmers.
- Development of a communications strategy aimed at raising awareness of the potential on-farm and broader ecosystem benefits of CA as well as relevant farming practices, technologies and other resources that are appropriate for different farming contexts.
- Adapting recent CA proposals to the Western Cape context made by AGriSA in its 2017 document on South Africa's Carbon Tax (refer to Annexure 5).

It is also recommended that SRM either designate an existing SRM Manager, or create a new post, with the responsibility for coordinating CA within SRM and for liaising with other stakeholders to strengthen the WCDoA support for CA. This process should include identifying opportunities to enhance SRM's contributions towards promoting CA in future as well as identify possible resource implications (including staff skills, capacity building) that will need to be addressed to strengthen the role of SRM in promoting CA in future. SRM's skills set and/or partnerships needs to be expanded to include, for example: Development of Farm Management Plans which include CA good farming practices; Implementing CA pilot projects across the various Districts; DRM conducting soil health risk assessments and monitoring

processes; Conducting research and providing information on relevant farming practices, technologies and other resources that are appropriate for different farming contexts.

Recommendation 5: Develop a more focused and efficient approach to LandCare projects and services and which includes at least the following initiatives:

Develop a formal Provincial LandCare Strategy and Implementation Plan which will assist in the provision of focused and efficient support to be provided by LandCare.

The Provincial LandCare Strategy and Implementation Plan should include at least the following: Principles which will guide LandCare, policy objectives, targeted beneficiaries, types of support that will be provided, high-level programme norms and standards that clarify good farming practices with respect to water, soils and vegetation (and to when beneficiaries will need to abide with in order to receive any support from LandCare), clear stakeholder roles and responsibilities, and an M&E framework for the monitoring and evaluation of the policy. In general, funding should be provided primarily for area-wide initiatives which address water and soil conservation and rehabilitation priorities (including CA). In addition, the Programme: SRM must consider the desirability and implications of introducing a more transparent process of providing funding for LandCare Projects whereby a transparent LandCare project funding application process is established and which requires the submission of business plans (as is the case in Kwazulu-Natal for example) and the assessment of these business plans by a LandCare Business Plan Assessment Panel including WCDoA: FSD and RD SRM: sub-programmes.

The Provincial LandCare Strategy and Implementation Plan may also need to take into account and align with the following elements of a more focused and efficient approach to be followed by LandCare:

a) Management of AVC projects by project managers (and not engineers).

b) Minimising the time of engineering staff involved in facilitating and managing area-wide management initiatives by outsourcing the secretariat and administrative processes

c) Outsourcing the EPWP job creation monitoring and reporting processes involved in AVC projects.

d) Outsourcing implementation of Junior LandCare and ensuring its content is revised to include content relevant to CA principles and good farming practices.

e) In terms of alien vegetation clearing, the Alien Invasive Species Strategy (AISS) will result in the identification of priority focus areas and this process needs to be finalised to inform LandCare's more programmatic and coordinated approach. The criteria to inform the identification of priority hot spots for AVC should be aligned with the AISS.

Recommendation 6: Take additional steps to enhance the efficiency and effectiveness of SRM such as the following:

a) Adopt and implement management processes to implement continuous professional development by developing staff development plans based on an analysis of their training needs and development of training plans. Staff should be encouraged (and incentivised where possible) to study or attend courses to keep up with the latest trends and technologies (including engineering technology).

b) Staff succession plans need to be developed, documented and implemented for at least the Chief Engineer's post and the Land-use Manager's post to reduce the risk of valuable experience, skills and knowledge being lost to the Programme SRM

in the areas of water resource management and land-use management and spatial planning.

c) Rotate staff members to other programmes/sub programmes/department if there is a specific skills/experience required to be improved to boost professional growth and internal programme capacity. This process can be managed by effective planning and communications between supervisors and staff.

d) More efficient administrative monitoring and reporting processes and systems (including those used to monitor and manage staff, targets and deadlines) by putting in place paperless IT automated systems wherever possible.

e) Continue providing staff whose main language is not Afrikaans with access to Afrikaans language courses or implement a working environment whereby bilingual persons adhere to speaking English as the universal language.

f) SRM: DRM to conduct a hazard vulnerability disaster risk assessment for agricultural soil health. There is a need to improve the agriculture sector's understanding of the multi-dimensional impact of soil quality over and above those on agricultural productivity as these extend to broader impacts on ecosystems, local climates and rainfall patterns, climate change and natural disasters.

g) SRM: Engineering Services to become more involved in testing technologies which can meaningfully contribute towards sustainable agriculture, agro-ecosystems, and sustainable use of natural resources (incl. CA, water usage and healthy soils).

   This could include documenting and quantifying the costs and benefits (where possible) so that improved information on the business case and feasibility of technologies is made available with the broader agricultural sector (including with smallholder farmers and CASP supported farmers). To incentivise this, SRM should consider the introduction of a new KPI into the APP to encourage more innovation in SRM. This could include making provision for staff to spend some time on exploring new technologies which stakeholders have expressed the need for more support in, as well as for innovative projects which SRM staff have identified and which have the potential to enhance SRM's impact on supporting government priorities, This KPI could be called "Innovation Initiatives" and/or or "Advice on new technologies" for example. There may also be a need to support staff with the above by linking training needs in these areas to staff capacity development plans.

   Examples of technology areas requiring further investigation by SRM are identified in sub-section 2.6.

h) Consider offering bursaries to support black engineers to part-fund their studies in return for these engineers taking up positions in SRM. In addition, bursaries should be considered for natural science studies.

i) Improve SRM: DRM Information management systems and processes to manage data on recipients of past disaster support as part of evaluating disaster support applications. Conduct a scoping exercise into the need to design a more integrated online application process and electronic database to manage farmer applications for disaster support.

3.4 Next steps

Programme: SRM needs to develop a management response to the evaluations recommendations, as well as an improvement plan to inform the next steps regarding actions that will be taken to implement selected recommendations.

This evaluation report needs to be made publicly available on the WCDoA's website.

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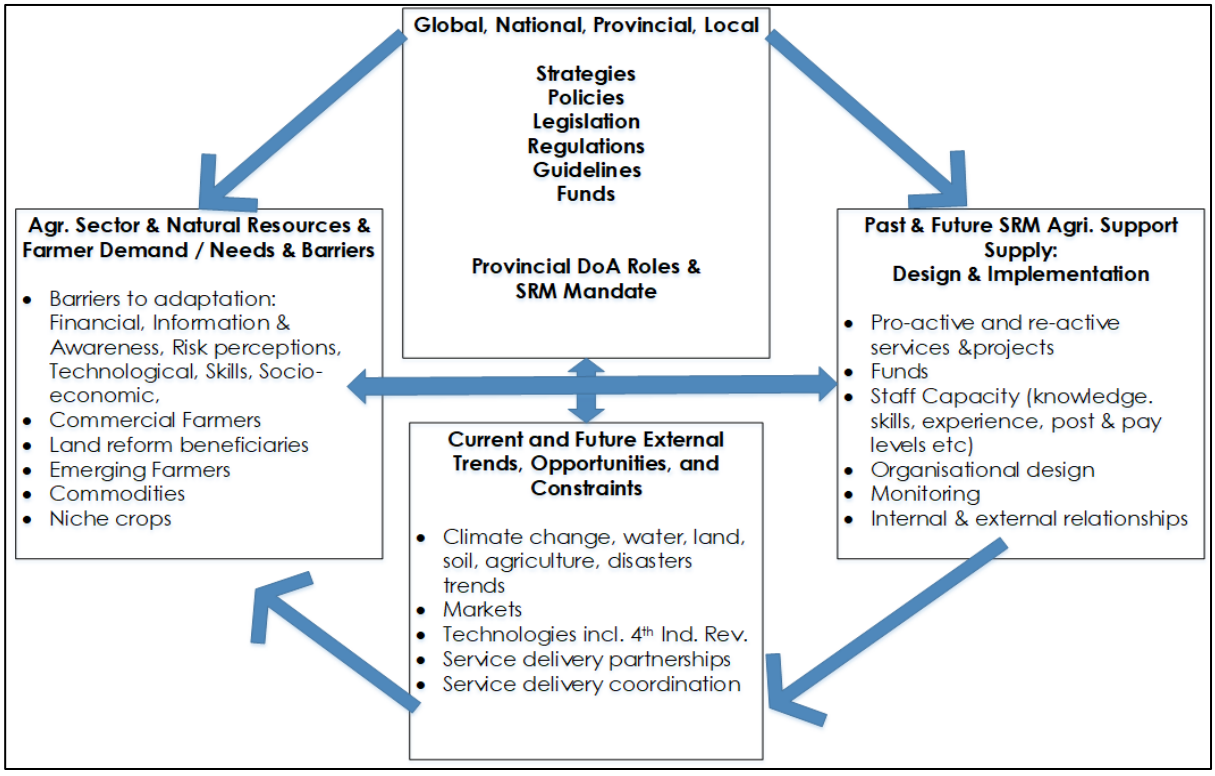
Annexure 1: Detailed Methodology

1. Inception process, evaluation framework and evaluation questions

The evaluation inception meeting took place on January 25, 2020. This meeting was followed by individual meetings with selected WCDoA SRM officials as well as a desk-top review of key SRM-relevant documentation. These meetings informed the identification of case studies to be included in the evaluation. An inception report and a desk-top review report was submitted containing the refined evaluation methodology.

The refined approach included a focus on identifying gaps, opportunities and constraints. The following framework identifies key aspects of this broader context:

Figure 2 SRM Evaluation Framework



Source: Impact Economix

Table 3 Refined SRM evaluation questions

Key Evaluation Question (KEQ)	Detailed evaluation questions
1. What is the current and planned service delivery profile of the SRM Programme?	1.1 What is the nature of the current SRM staff capacity? 1.2 What kinds of services are currently being delivered to who and how (i.e. key processes followed, as well as internal relationships between the sub-programmes and external relationships between the SRM programme and other WCDoA and WCG programmes, external government departments, service providers, and beneficiaries) by SRM staff in each of the sub-programmes? This includes identifying what external institutional structures SRM officials either participate in/ are represented on and/or support in one form or another.

Key Evaluation Question (KEQ)	Detailed evaluation questions
	1.3 What is the current 2020/21 annual SRM budget allocation towards each SRM sub-programme and its main types of activities/projects? 1.4 What is the expected future 3-5 year medium term SRM budget allocation towards each SRM sub-programme and its main types of activities/projects?
2. What can be learned from case studies regarding what worked well and what did not in terms of design and implementation and contribution to the SRM mandate (including achievement of 'Strategic Objective 1 - To promote the optimal and sustainable utilisation of the Western Cape land and water resources' and 'Strategic Objective 2 - To render engineering services to increase production and farming feasibility'?	1.1 Who did what, why (incl. what were the main problems the case study was aimed at addressing), and how and when? 1.2 What is the history and context to the Case Study? 1.3 What were SRM's objectives in the case study? 1.4 What were and are the main role-players involved and roles played (roles that main role-players should have played and roles that main role-players actually played in practice), processes followed (from project identification, feasibility, prioritization & selection, planning, implementation, monitoring, post-evaluation and up to the current period) utilised resources (financial and human) activities, projects, services, and service delivery relationships (internal within WCDoA and external to WCDoA)? 1.5 What kind of resources were or are being utilized in implementation and fulfillment of the project goals, and how were/are those resources acquired? 1.6 How unique and innovative was the approach taken/ solution(s) and in what way? 1.7 Does the initiative adequately address the full project cycle (e.g. from needs assessment, design, implementation, maintenance, monitoring, and rehabilitation and termination where relevant)? If not, why not, and what could or should have been done differently to support a holistic approach)? 1.8 What expectations did and do key relevant role-players have towards SRM? To what extent have these been met and why? 1.9 How re-active and/or pro-active were the implemented solutions? 1.10 What risks were identified and managed (well or not) and what risks were not identified and/or managed? 1.11 What could have been done better (e.g. more pro-actively) to mimimise or avoid the addressed sustainable resource challenges, make a bigger impact on addressing either climate change mitigation (i.e. reducing green-house-gas emissions) and/or adaption (reducing the negative impacts of climate change on agricultural production), and/or contribute towards improved farming production and/or feasibility as well as sustainability (e.g. improving the resilience of agro-ecosystems for water availability, soil health etc.)?

Key Evaluation Question (KEQ)	Detailed evaluation questions
	1.12 What was achieved and not achieved- both positive and negative results? Broadly, what kinds of farmers and/or other beneficiaries received what kinds of benefits? Were there other relevant needs (to the SRM mandate) that were not addressed and if so, what might the potential implications be and what could these mean for the SRM in the future? 2. How did it address and change the previous situation and the problems? If it is a programme in progress how it is progressing/what are the tangible demonstrated results thus far? What were the other unintended results achieved. 3. What were the major obstacles and if they were overcome, what method was used to do that? 3.1 How did the SRM role, service, and or project contribute to any of the following: • Climate change mitigation (reduced GHG emissions) and/or adaptation e.g. (improved resource use efficiency, ecosystem health/ functioning etc.)? Could things have been done differently to increase the positive impacts on climate mitigation and/or adaptation? • Farming feasibility and/or sustainable production incl. agro ecosystem resilience. 3.2 What could or should have been done differently? What opportunities exist/ existed to improve SRM implementation and effectiveness? 3.3 What gaps and/or constraints and/or problems and/or opportunities can be identified in the approach followed, including roles played by SRM as well as availability of required resources (staff capacity, funding etc.)? How did the project deal with issues of integration, co-ordination? How should these be dealt with by SRM in future? 3.4 What should the SRM do and not do in future? 3.5 What lessons can be learned in terms of what worked well and what did not with respect to SRM's design and implementation and in terms of what SRM should or should not be doing in future? 3.6 What are the potential implications of the above in terms of improving the future design, effectiveness and efficiency of the SRM Programme (i.e. what should the SRM be doing in future, how, and what kinds of skills resources are required for SRM to function effectively)?
3. What can be learned from other internal WCDoA as well as organisations linked to the WCDoA	1.1 What is the nature of the current relationship between the SRM Programme and the organisation? 1.2 Is the organisation aware of the SRM' mandate? 1.3 What is the organisation aware of regarding the role played by (including services delivered) the SRM programme?

Key Evaluation Question (KEQ)	Detailed evaluation questions
and/or SRM Programme regarding service delivery arrangements, opportunities, and gaps to inform the SRM's future design, priorities, approach and implementation (roles, capacity)?	1.4 Is the organisation also involved in playing a role and/or delivering services relevant to supporting the SRM's mandate? If so, describe relevant initiatives and clarify any differences in approach between the organisation's activities and the SRM programme. 1.5 What are the main expectations that the organisation has regarding the role to be played by SRM (including key focus areas and services) in terms of contributing towards: • Climate change mitigation (reduced GHG emissions) and/or adaptation e.g. (improved resource use efficiency, ecosystem health/ functioning etc.)? Could things have been done differently to increase the positive impacts on climate mitigation and/or adaptation? • Farming feasibility and/or sustainable production 1.6 To what extent are these expectations currently being met or not? If not, what does the organisation believe needs to take place to narrow the gap between expectations and the role played or service delivered by the SRM? 1.7 Are there any issues of coordination and/or efficiencies (including duplication and/or fragmentation and dilution of required resources) between the SRM programme and the organisation (as well as other organisations)? 1.8 Are there challenges and/or needs and/or gaps and/or opportunities relevant to the SRM mandate / SOs that the organisation believes the SRM should or could play a role in better addressing (if so describe these in detail as well as why the SRM could or should play a role in addressing these)?
2. Synthesis conclusions and recommendations: How can the design, efficiency and, reach of the Programme SRM be improved such that the Programme as a whole has a sustained, broader and greater impact?	2.1 What unique contributions/ initiatives and value add has each sub-programme made towards SO1 and SO2? 2.2 What constraints limit the ability of the SRM programme to deliver on its mandates? 2.3 What areas need improvement (including improved interaction with external and/or internal role-players) or restructuring for each of the sub-programmes? What are the high-level human resource capacity implications? 2.4 What are the main lessons learned relevant to SRM's future role and services? This includes: 2.4.1 What SRM services/ activities are core vs peripheral to the SRM mandate? 2.4.2 What opportunities and strategies exist to improve achievement of SO1/SO2, climate change adaptation and mitigation and agro ecosystem resilience outcomes at greater scale (including opportunities for improved interaction / co-working with external and internal stakeholders) for each sub-programme as well as improved utilization of 4th Industrial Revolution

Key Evaluation Question (KEQ)	Detailed evaluation questions
	technologies (and what recommendations from the 4th IR evaluation are relevant)? 2.5 How can the design and effectiveness of the Disaster Risk Management Sub- Programme's response to disasters be improved, and what element of pro- active planning can and should be introduced? What should the SRM not do in future? 2.6 What should be the core focus and structure of the Land Use Management Sub- Programme to ensure effective preservation of agricultural land use; and what elements of pro-active planning can be introduced? 2.7 What does a Theory of Change look like for a potential improved SRM Programme? 2.8 What kinds of skills and resources are needed to support recommended future SRM roles and services?

2. Data collection approach, data sources and data collection instruments

A mixed methods approach was followed to enable the collection of both qualitative and quantitative data from a range of sources which allow for strong evidence to answer each evaluation question and triangulation in the analysis phase. This means that, wherever possible, either data from more than one source, and/or data of different types (quantitative or qualitative) will be collected to provide strong evidence when the data is analysed.

In addition to a wide range of documents the main data sources included the following:

- 7 Case studies (key informant interviews and document analysis)
- Survey of current and past SRM staff
- 60 Key informant interviews with key internal and external stakeholders and role-players.

Case studies

Case studies tend to be appropriate where it is extremely difficult to choose a sample large enough to be statistically generalisable to the population as a whole; where generalisation is not important; where in-depth, usually descriptive data is required; and where the cases or projects to be studied are likely to be quite complex.

One key limitation of this technique is that minority views are often not represented in the findings.

The following case studies have been selected on the basis of the following criteria:

- The case studies are known cover initiatives that were either known to work well in terms of providing relevant support, as well as initiatives where challenges were experienced in providing relevant support. They are thus a rich source of lessons to inform improvement to future SRM design and/or implementation.
- The case studies cover a range of different types of services provided by the various SRM sub-programmes.

The case studies are as follows:

Table 4 Case studies for SRM Evaluation

SRM sub-programme	Case studies
Engineering	a) River protection solutions: a) Brandwacht project b) Tesslersdal project
Disaster-management	b) Provision of fodder support(including the bi-annual veld assessments)
Land-use management	c) Three different types of applications: a) Geelhoutboom b) Harold Meander c) Sir Lowry's Pass
LandCare	d) Review of LandCare evaluations case studies, findings and recommendations to inform analysis and way forward recommendations.

The following case study reporting logic/ outline has been used to document these case studies and this informed the design of our data collection instrument/ key informant interview frameworks for the case studies:

a) Background

b) Problem

c) Method / Intervention / Solution Used:

d) Results achieved:

e) Lessons learned

f) Conclusions

Key informant interviews

A shared database of stakeholders was made available to SRM: Management and SRM Management identified additional stakeholders to be included in the key informant interviews.

Data collection instruments were developed to focus the interviews as tailored for each sub-programme and specific type of stakeholder.

A total of 60 Key informant interviews took place with a wide variety of key stakeholders either linked to the SRM programme and/or or engaged in activities which also impact on the SRM's aims and/or related to case studies to be included in this evaluation. A few interviews were conducted face-to-face, however, due to the COVID-19 regulations, most interviews were conducted using video technology.

Key informant interviews took place for the following reasons:

- To understand the nature of the relationship and interactions between SRM and related initiatives
- To understand case studies in terms of who did what and how and what results were achieved and lessons learned.
- To explore existing and potential opportunities to enhance SRM effectiveness.

Key informant interview guides were structured to focus on various themes, including:

a) Awareness of SRM programme support?

b) Nature of interactions/ linkages with SRM programme. If there are existing linkages, perceptions of the benefits/ challenges/ constraints of these linkages and whether/ how linkages can be improved to enhance alignment/ benefits/ contribution to SRM mandate?

c) Whether organisation is also playing a role in contributing towards SRM aims of sustainable use of land and water and improved farm feasibility (and whether working with same/ different SRM target farmer groups or different) and if so kinds of projects/ initiatives organisations currently busy with and/or planning for the future as well as whether duplication and/or conflicts w/ SRM exist?

d) Views on what current/ future gaps in support relevant to achieving SRM aims?

e) Views on what SRM could/should be doing differently to enhance impacts on SRM aims. These could include how to better realise opportunities and enhance synergies and/or leverage complementary resources (esp. re pro-active approaches to address root causes of unsustainable natural resource use/ patterns).

All interviews were conducted anonymously and confidentially to protect the sources of all information as well as to encourage open and honest inputs into this evaluation.

A total of 60 key informant interviews were conducted with the following relevant stakeholder organisations:

Table 5 List of key informants interviews for the Programme: SRM Evaluation

First name	Surname	Institution
1) Elton	Jefthas	African Farmers Association of South Africa : Western Cape Chairperson
2) Ismail	Motala	African Farmers Association of South Africa: Western Cape Spokesperson
3) Jannie	Strydom	Agri Western Cape: CEO
4) Hennie	van der Merwe	Agribusiness Development Corporation: CEO
5) Felix	Reinders	Agricultural Research Council: Research Team Manager: Irrigation and Drainage Engineering
6) Billy	Bourbon Leftley	Berg River Main Irrigation Board: CEO
7) Anel	Blignault	Blue North: Project Manager: Confronting Climate Change - Fruit & Wine Industry Initiative
8) Elkerine	Rossouw	Breede Gouritz CMA: Manager: Environmental Scientist
9) Dean	Impson	Cape Nature Conservation: Resource Ecologist Fauna | Biodiversity Conservation:

First name	Surname	Institution
10) Ramakgwale	Klaas Mampholo	DALRRD: Deputy Director: LandCare
11) Dr I.B.	Kgatatsi	DALRRD: Directorate: Climate Change and Disaster Risk Reduction: Chief Director
12) Mary Jean	Gabriel	DALRRD: Director: Water Use and Irrigation Development
13) Jackson	Mokwatedi	DALRRD: Directorate: Climate Change and Disaster Risk Reduction: Agricultural Economist
14) Mahlatse	Phuthi	DALRRD: Directorate: Climate Change and Disaster Risk Reduction Deputy Director: Early Warning
15) Solomon	Matsa	DALLRD: Climate Change and Disaster Risk Reduction: Agricultural Scientist
16) Menard	Mugumo	DHSWS: Chief Engineer: Options Analysis
17) Inge	Kuschke	Green Cape: Agriculture Manager
18) Christiaan	Stymie	Independent consultant/ agricultural engineer
18) Johan	Matthee	Lower Olifants Water User Association: CEO
19) Mashudu	Marubini	National Department: DAFF; Land Use and Soil Management: Deputy Director
20) Pierre	Lerous	PJ Lerous Town and Regional Planning Consultants: Managing Director
21) Lavenia	Nicholson	Provincial Disaster Management Center: Deputy Director: Preparedness and Response
22) Nomthandi	Losi	Provincial Disaster Management Center: Assistant Director: Disaster Recovery
23) Jacqueline	Pandaram	Provincial Disaster Management Center: Director: Disaster Operations
24) Isobel	van der Stoep	Manager: Design and Consulting, at Cherry Irrigation
25) Stiaan	Carstens	Stellenbosch Municipality: Senior Manager: Development Planning (including Land Use Management): Development Planning and Economic Development
26) Anthony	Barnes	Stellenbosch Municipality; Director: Planning & Economic Development (incl Human Settlements: Development Planning and Economic Development
27) Bernabe	28) De La Bat	Stellenbosch Municipality Manager: Spatial Planning: Development Planning and Economic Developmen
29) Craig	Alexander	Stellenbosch Municipality; Senior Manager: Development Planning: Development Planning and Economic Development
30) Widmark	Moses	Stellenbosch Municipality: Manager: Local Economic Development & Tourism: Development Planning and Economic Development
31) Heinrich	Schloms	Vinpro: Soil Scientist
32) Elkerine	Rossouw	Breede-Overberg Catchment Management Agency: Water Use Specialist
33) Matoti	Bongiswa	WCDoA Programme: Agricultural Economics: Director
34) Charl	van Rooyen	WCDoA Programme: Farmer Support and Development: Specialist Agricultural Advisor

First name	Surname	Institution
35) Jerry	Aries	WCDoA: Programme Farmer Support and Development: Acting Chief Director Farmer Support and Development
36) Theuns	Breytenbach	WCDoA: Programme SRM: Engineering Services: Control Engineer
37) Peter	Keuck	WCDoA: Programme SRM: Engineering Services: Chief Engineer
38) Adriaan	Conradie	WCDoA: Programme Farmer Support and Development: Acting Director: Cape Metro/Overberg
39) Deon	Heydenrych	WCDoA: Programme SRM: Engineering Services: Mechanical Engineering Technician
40) Hans	King	WCDoA: Programme SRM: Engineering Services: Production Engineer (Retired)
41) Andre	Roux	WCDoA: Programme SRM: Director (Retired)
42) Johan	Roux	WCDoA: Programme SRM: Engineering Services: Agri-processing: Engineer
43) Darryl	Jacobs	WCDoA: Head of Department
44) Dr Johann	Strauss	WCDoA: Programme: Research and Technology Development (RTD): Scientist: Sustainable Cropping systems: Directorate: Plant Sciences
45) Ashia	Petersen	WCDoA: Programme SRM: Director
46) Leslene	Laven	WCDoA: SRM: Disaster Risk Management: Administrative Assistant
47) Najma	Adams	WCDoA: SRM: Disaster Risk Management: Candidate Engineer
48) Jody	Wentzel	WCDoA: SRM: Disaster Risk Management: Assistant Director
49) Cor	van der Walt	WCDoA: SRM: Land Use Management: Land Use Manager
50) Francis	Steyn	WCDoA: SRM: LandCare: Deputy Director: LandCare
51) Jephtas	Grant	WCDoA: SRM: LandCare: District Manager: Overberg
52) Smit	Jan	WCDoA: SRM: LandCare: District Manager: West Coast
53) Pienaar	Phyllis	WCDoA: SRM: LandCare: District Manager: Central Karoo
54) Roescher	Rudolph	WCDoA: SRM: LandCare: District Manager: ,Cape Winelands
55) Muller	Hannes	WCDoA: SRM: LandCare: District Manager: George
56) Marlene	Laros	Western Cape: DEA&DP: Director: Biodiversity and Coastal Management
57) Catherine	Bill	Western Cape: DEA&DP: Scientist: Water and Pollution Management
58) Wilna	Kloppers	Western Cape: DEA&DP: Director: Water and Pollution Management
59) Kobus	Munro	Western Cape: DEA&DP: Development Planning: Director Development Management: Region 2
60) Ayub	Mohammed	Western Cape: DEA&DP: Chief Director: Environmental Governance, Policy Coordination and Enforcement

Survey (internet-based) of current and SRM staff.

The purpose of this survey was to:

- Develop a base-line profile of current staff capacity (incl. qualifications and experience) in each sub-programme as well as a profile of what staff are involved in delivering specific SRM services
- Inform an analysis of staff capacity constraints both in terms of staff numbers, staff workload, and staff qualifications and/or professional accreditation as well as alignment between staff qualifications and experience and main work functions performed.
- Inform an understanding of what provided services / projects benefit different types of beneficiaries.
- Inform an understanding of service delivery linkages between the SRM sub-programmes.
- Identify staff suggestions which may inform recommendations for possible programme design, effectiveness and efficiency improvements.

A total of 48 current SRM staff completed the survey and 6 past SRM staff who has left the employ of the SRM programme in the past 2-3 years.

Annexure 2: Identified Gaps, Challenges and Opportunities for SRM sub-programmes

The following constraints, gaps and opportunities relevant to the SRM sub-programmes have been identified through a wide range of key informant interviews, as well as SRM staff survey responses, conducted as part of this evaluation:

Table 5 SRM: Engineering services: Gaps, opportunities and constraints

WCDoA; SRM: Engineering Services Gaps and opportunities	WCDoA; SRM: Engineering Services Constraints
Opportunities include the following • More research and testing and promotion of technologies, including those that advance CA / Precision and Climate Smart Agriculture (e.g. increased use of drone technology for surveying and more efficient use of pesticide and fertiliser application can reduce fossil fuel use). According to WCDoA: R&TD Programme, this programme does not test new technologies as "government funds can be used to test new private sector products)". • In-house development of mobile applications to improve SRM service delivery: For example, SRM Staff have proposals for developing mobile phone applications with the potential to improve communication between SRM and FSD to enhance services to smallholder farmers as well as ideas for applications that can improve communication between LandCare, Nature Conservation, Environmental Services and producers next to rivers that will result in better service to clients and improved resource conservation. Provide staff with platforms to discuss innovative ideas to solve problems (old and new problems) and allow staff to experiment and come up with new ways of doing things. Where skill capacity is not available within SRM and an external service is required, ensure that internal staff members also directly participate in the process to strengthen and build internal capacity. • SRM: Engineering can potentially play a critical role in identifying critical major water infrastructure maintenance needs and priorities and use its political influence to ensure that the DWS allocates budgets to address these. In addition, facilitating	• Major threats to future agricultural production in the Western Cape exist if dams and canals are not urgently maintained and/or expanded. Funding from national government/DWS/ Treasury/ TCTA are urgently required to address this issue. SRM capacity to play a facilitation and lobbying role to address this complex issue is critical. • Irrigation schemes in the Western Cape have battled to supply water at a 90% assurance level due to insufficient availability of water. WCDoA and DWS are busy with a number of strategic projects to improve the water supply assurance levels. • The availability of funding to maintain water canals is severely limited as DWS and WUAs funding sources are insufficient given the neglect of this infrastructure over the past +-80 years. This lack exacerbates water losses due to leaks and SRM: Engineering has intervened in some cases to supply funding. • Subsidies for smallholder farmer exists, however, there is reportedly a lack of clarity on who is responsible for what in this regard (key informant interview). Providing irrigation and other equipment to smallholders is vital, however, it is important that an effective extension support system is in place to work closely with these farmers and that the level of technologies is appropriate to the farmers level of skills and resources incl. ability to maintain such equipment. • Perceptions exist that strategic irrigation initiatives may not sufficiently benefit smallholder farmers. In addition, it is unclear if the CCAW is functioning effectively and meaningfully enhancing access to water for smallholder farmers. • Innovation and technology not encouraged by the current APP KPIs which largely focus on

WCDoA; SRM: Engineering Services Gaps and opportunities	WCDoA; SRM: Engineering Services Constraints
planning, feasibility, and funding of strategic water supply augmentation projects to expand agricultural production, job creation and productivity and increase equitable access to water for smallholder farmers. WCDoA and SRM is able to leverage national funding from DWS and ensure DWS fulfils their responsibilities to maintain and fund new strategic water infrastructure projects. This Requires SRM to be equipped to engage at strategic level to deal with cross cutting resource management issues. **Internal constraint:** SRM needs suitable human capital skills for the assessment, upgrade, refurbishment and development of existing and new water supply schemes. • It is not clear if conducting a Strategic Environmental Assessment process for maintenance of all dam canals in the Western Cape would be a more efficient way to complete the EIA processes for all dam canals in one process (as opposed to separate EIA processes for each canal. The SEA process has been successfully facilitated by the CSIR. It must be clarified if dam canal maintenance requires EIAs or not. • Clarify whether SRM: Engineering/ LandCare can play a greater role in reducing agricultural water use wastage and improve water use (Agriculture consumes about 60% of all water in South Africa) over and above Fruitlook. Two SRM opportunities have been identified by key informants for further exploration: 1. SRM playing a more pro-active role in ensuring farmers have installed water use metres (There may be tensions re WDS regulatory enforcement policing role vs WCDoA's support role). 2. Strengthen the links between the Confronting Climate Change Initiative (involving an online carbon sequestration tool and a partnership between Blue North and the WCDoA in the fruit and wine industry) and SRM: Engineering and SRM: LandCare technical advice and designs for soil and veld conservation works and clarifying how these can impact on improved carbon sequestrations. A simplified carbon tool could be developed for smallholder	numbers of projects. The APP output targets focus on numbers of projects and do not encourage or incentivise pro-active exploration or innovation in testing new technologies (and which may require far more time to develop than most projects). Consideration needs to be given to APP targets for "Innovation Initiatives" and which may require dedicated internal provincial funding (i.e. not funded from equitable share sources). Mechanical engineers, especially, could play a role in exploring new technologies. • There is a lack of understanding within WCDoA of the differences between Engineering Technicians (who can solve well defined problems), Engineering Technologists (who can solve moderately defined problems, and Engineers (who can solve complex problems). Some believe that candidate engineers can do the work of engineers, however, this results in problems. Due to a lack of engineering skills, the scope for the Chief Engineer to delegate work downwards is limited. Poor irrigation designs can result in very large increases in irrigation project operating and maintenance costs over the 20-30 year life-cycle of a project. • On the engineering side more seniority in engineering staff located at District field offices is needed to allow for quicker decisions • There has been a progressive collapse in SRM's engineering capacity linked to an inability to recruit and retain adequately trained technical personnel for the department in fields identified as scarce and critical skills. Given the large number of engineers approaching retirement age, there is a serious risk that the SRM programme will lose much of its engineering skills and expertise. There are insufficient numbers of in-house registered engineers and technicians to oversee/approve and sign-off work done by SRM staff. The use of internships, while well intentioned, is not sufficient to build SRM's capacity as there are insufficient opportunities for interns to get exposed to practical project experience and intern's level of qualifications are too low. • Some staff are concerned that the appointment of new staff currently does not sufficiently take into account qualification and skills and does not sufficiently contribute

WCDoA; SRM: Engineering Services Gaps and opportunities	WCDoA; SRM: Engineering Services Constraints
farmers. This must be linked to smallholder farmer development of the carbon trading market in South Africa • Pilot/demonstration projects at farm level. Opportunities: Planning and design of small scale water resource structures for smallholder and smallholder farmers. Requires use of in-house staff to manage engineering projects and this will have additional benefits of improving practical skills and experience and for improving staff motivation. As the current staff of 3-4 with the necessary irrigation experience is too small, there is a need to re-focus SRM: Engineering staff who have irrigation experience but who are currently working in other areas (e.g. Animal Structures). • Strengthening the agriculture sector's contribution to South Africa's National Defined Contributions to addressing climate change through reducing carbon dioxide as well as Green-House-Gas emissions (GHGs) through a variety of measures, including: Supporting better farming practices such as CA/ Regenerative agriculture (as informed by lessons learned from the Rooibos CA initiative), Precision agriculture, and greater use of renewable energy technologies (specific RE opportunities include wind turbines, CSP and PV (for solar cooling and heating purposes as well as agro-processing). Renewable energy is now cost-effective compared to electricity and a need exists for pilot/ demonstration projects using affordable technologies (possibly in collaboration with FSD). Internal constraint: Internal engineering experience and expertise to provide support and advice for renewable energy options appropriate to the needs and expertise of smallholder farmers. External constraint: Funding for renewable energy projects. • Engineering staff development in terms of career growth (ECSA. **Internal Constraint**: Staff do not get exposed to sufficient diversity of work experience in order to meet the ECSA registration requirements. • SRM has been allocated R43 million for 21/22-23/24 for ecological infrastructure (R30 mil. of this is for river rehabilitation).	towards improving engineering skills or capacity in SRM. Service delivery may be negatively impacted upon as a result of the lack of succession planning due to skills shortages. At the same time, some engineers are not primarily focused on work aligned with their engineering qualifications and skills. • Transformation of the race profile of engineering staff is a slow process and it takes years to transfer engineering skills. Engineering competencies need to be retained and strengthened but insufficient emphasis is being placed on achieving this. In engineering, cultural challenges may exist, for example, where black engineers are more comfortable with a group or community-based decision-making approach which can be in tension with the need for engineers to take individual responsibility and make clear decisions and provide advice on whether solutions will or will not work. • The internal organisational management culture is perceived by some staff as focusing excessively on internal controls as opposed to focusing on external clients and service delivery. This internal control focus is coupled with an administrative burden which requires excessive staff time and this is not seen as conducive to effective and efficient work related performance. REFER TO STAFF SURVEY • There is no career path for technicians above Control Technician post. Technicians need to be promoted to the Control Technician's salary leg after reaching their top salary notch. • SRM's experience and expertise in participating in broader Provincial and National Water Resource Management initiatives largely depends on the Chief Engineer and a risk exists that no succession and skills transfer plan is in place to ensure that 1 or more alternative SRM official can be exposed to these initiatives and start to develop relevant water resource management knowledge and experience • Maintain a productive relationship with DWS re water resource planning and DWS role as asset owners and custodians is a challenge. Engineering Capacity at DWS has been declining over the years and is likely to result in important problems and challenges impacting

WCDoA; SRM: Engineering Services Gaps and opportunities	WCDoA; SRM: Engineering Services Constraints
Requires a clear strategy to inform the identification and prioritisation of river rehabilitation projects using clear criteria and including identifying areas most at risk of flooding as well as the magnitude of potential positive impacts (e.g. size of land under production at risk, numbers of farmers etc.) by avoiding or minimising flooding and river erosion. • Improved collaboration between SRM sub-programmes. Internal constraint: The focus on achieving APP output targets does not support collaboration between SRM programmes as collaboration is not recognised by any of the sub-programme KPIs contained in the APP. • Improved collaboration between SRM: Engineering and SRM: DRM to develop hazard mitigation plans for flood hazards. • Improved collaboration with WCDoA: Agricultural Economics Programme which is responsible for the Agriculture BEE Programme funding for agri-processing projects. SRM: Engineering needs to play an oversight role with AE and assist with managing service providers and signing off designs (with the assistance of external service providers if necessary). • Opportunity for SRM Engineering to assist to develop small scale processing machinery for niche crops (e.g. a distillation plant for essential oils).	on water resource management in the Western Cape in future. • Building plan regulations require that agricultural structures need to be signed off by a suitable processional (i.e. structural engineer or architect) and this limits SRM: Engineering services ability to provide detailed animal structure designs.

Table 6 Programme SRM: LandCare Management: Gaps, opportunities, constraints

WCDoA: LandCare Gaps and opportunities	WCDoA: LandCare Constraints
• Key gaps include the following (some of these may also be opportunities to address moving forward): o Insufficient focus on Conservation Agriculture and Soil conservation projects to ensure soils are farmed sustainably and weakened CA technical skills (SRM lacks soil scientist expertise although this does reside in WCDoA: R&TDS where soil tests are conducted). Need more focus on conservation of natural resources (especially soils) on farms and supporting good farming practices. Support good farming practices with water, soil, cover and cultivation. In addition, there is an insufficient monitoring of soil health (which is broader than soil nutrition and includes organic matter for example) in the Province. The development of new generation Farm Management Plans is one opportunity to address these issues. o No funding for soil conservation works incl. erosion prevention structures/ erosion control (unclear if CASP can provide funding for this?) o Weakening of capacity to do civil engineering work and a perceived lack of focus on using staff skills to prioritise support for smallholders? Integration with WCDoA FSD and Land Reform needs to be strengthened (where ideally farm management plans should be developed by SRM very early on in the land reform process and can inform CASP funding needs and applications. LandCare reports, however, that there are not enough land reform farms). o Capacity to provide smallholder farmers with small scale irrigation development has fallen away to the point where there are only 3-4 officials across SRM: LandCare and SRM: Engineering that can still provide this support. o Assisting farmers with good farming practices (esp. related to sustainable use of natural resources such as water management at farm level and sustainable soils). The development of new generation Farm Management Plans is an opportunity to address this. o Project funding should focus on agricultural resource protection, including soil health and rehabilitation amongst other issues. o Lack of holistic farm planning where farms are complying with global standards required to export (e.g. Global Gap, Fairtrade) but still practice environmentally harmful practices which are not taken into account by these standards (e.g. river passing through the farm is overgrown by aliens and	• Lack of shared clarity on LandCare priorities and focus as this has largely shifted scarce staff resources towards managing AVC and away from the still very relevant CARA objective of ""To provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.". • Salary/ post levels are too low to motivate engineers/ technicians to come and work for SRM. With the last WCDoA adjustments that was specifically for scarce skills (engineers and doctors) everyone in Dept. Agriculture benefitted from salary adjustments, except SRM (i.e. the engineers and engineering technicians). • Lack of technical exposure • Too much focus on job creation and too little on technical work of agricultural natural resource protection and development mitigation. EPWP funding received of about R4 mil. for labour intensive AVC is very administratively intensive in terms of monitoring and reporting so that "transaction costs of managing these funds might be more than the value of funds received" and is better suited to project managers vs the use of engineers (key informant interview). • Lack of trust within SRM (key informant interview- no further details of the specific causes and nature of trust issues was provided). • The procurement of project supplies and the long waiting

WCDoA: LandCare Gaps and opportunities	WCDoA: LandCare Constraints
cause erosion, illegal damping sites and pollution) (this should be addressed through new generation FMPs). o Ensure SRM staff gain experience and skills. More training practical programs (and not just class room training) needs to be made available. Including training on soils so that technicians have the required skills to assist farmers to improve soils. o Ability to develop the necessary skills and provide services requested from clients. Adopt the principles of continuous professional development by developing staff development plans based on an analysis of their training needs and development of training plans. o Not commenting on EIAs. o Lack of environmental support services and staff at the District level. o SRM: LandCare is represented on many committees/ structures but does not necessarily represent the broader SRM mandate and SRM does not necessarily receive feedback on issues raised and decisions made in these structures. SRM representation on committees now needs to be first approved by the WCDoA: HOD (key informant interview). • Additional opportunities include the following: o Pro-active Area Wide Planning solutions together with partners and the implementation of projects that make a big impact on the health of the natural resources and mitigate the effects of climate change. Ideally embedded in policy, to address common needs/risks for farming communities in terms of SRM. To include jackal-proof fencing. o Farm Management Plans (especially to support WCDoA FSD and Rural development programmes including land reform projects) that includes water balance, NRM risk assessments and Conservation Agriculture activities - linked to existing accreditation norms and standards in the private sector (to give value to the client). o Pro-active support for increased adoption of Conservation Agriculture practices. This could include compiling factual and practical videos on effective Conservation Agriculture practises in a variety of conditions for farmers to showcase success stories. o Provide more technical and engineering support advice to other programmes, departments and land users. o Financial assistance with regards to natural resources / ecosystem infrastructure.	period for tenders to be evaluated and awarded. • Lack of staff with environmental science qualifications to support ecosystem approach. • Not utilising existing skilled staff in their fields of expertise. • Lack of good data and data management system on AVC in is in the process of being improved, including which organisations are working on AVC as well as spatial data on the state/ level of invasion. The EIIF is trying to address this issue. • Piggery and livestock manure management is sometimes deficient and can be highly polluting to rivers (esp. from informal settlements). Lack of finances to address these challenges is reportedly a problem. Issuing directives to address the problem under the Water Act (or NEMA or CARA) does not necessarily solve the problem and this requires action at a national level to address.

WCDoA: LandCare Gaps and opportunities	WCDoA: LandCare Constraints
o Erosion control on cultivated land, in rivers and wetlands (incl. focusing on low-budget technical work to prevent soil erosion, such as Eco-logs). o Less Expensive River protections. o Assist financially constrained farmers to adhere to requirements set out for them to receive funding from department WCDoA (e.g. CASP) if they fall within Ecosystem Investment priority areas). o Provide funding subsidy for fencing, alien clearing and help only contributing landowners. Will do more with available budget. o Investing in Research and Technology that could transform the way of farming. o Enable farmers to make use of natural fertilizers and herbicides. o Use AVC to support the establishment and growth of black-owned small businesses that process the AVC waste for energy generation to support further processing and/or manufacturing.	

Table 7 Programme SRM: Land-Use Management: Gaps, opportunities, constraints

WCDoA: SRM: Land-use management Gaps and opportunities	WCDoA: SRM: Land-use management Constraints
• The WCDoA faces a large risk of losing its capacity to comment on development applications if it was to lose its one manager responsible for commenting on these applications for whatever reason. There is a need to ensure that a succession place is put in place by employing additional professional staff who can support the land-use manager in reviewing and commenting on applications. Such a post would need to be for a professional position and at a post level and salary band that is capable of attracting a candidate that has at least 5-10 years practical experience in land-use management and who has sufficient knowledge of relevant legislation, agriculture and other issues previously identified in this report section. With this additional capacity in place, it will be possible for the current SRM manager to both initiate additional pro-active measures which can improve the response rate and response times of applications as well as to make time available to build additional internal capacity through skills transfer to 1 or more graduate interns. • There is an opportunity to explore the delegation of approval authority by DALRRD to SRM Land use management for certain sub-divisions and consolidations below a specific land area size to enhance SRM: land-use management effectiveness and efficiency. However, this will require increased administrative staff capacity due to the additional administration involved. • Key identified SRM: Land use management gaps linked to the insufficient human resources include: o Lack of an applicable Policy document on norms and standards; o Lack of pro-active spatial planning; o Lack of internal land-use management capacity building; o Inability to always adhere to stipulated legislative time-frames for responding to development applications. o Insufficient capacity to engage in sufficient pre-application consultation processes both to advise applicants as well as to coordinate inputs with Municipalities, DALRRD, and DEA&DP (and other relevant departments incl. Human Settlements, Economic Development & Tourism etc.) o Capacity to engage with Municipalities early on in the SDF drafting process to ensure that adequate provision is made for the protection of agricultural land in relation to urban edges. SRM Land use management participates in Municipal Steering	• SRM: Land-use manager is unable to evaluate all applications due to the shortage of staff within the required turnaround time. • SRM: Land-use management is unable to attend to all requests received for comment on changes to legislation, regulation and policy and proactive comment on new developments and technology which could impact on land use management activities. • Unrealistic to expect LUM manager based at head-office to comment on Environmental Impact Assessments as this requires detailed local knowledge. Opportunity exists for LC officials to be involved in commenting on EIAs. • Salaries - salary levels too low to draw and retain suitably qualified staff and who also have practical experience • Lack of career advancement and training - Capacity constraints makes it Impossible to train young professionals taking management responsibilities and volume of work (line-function) Into account.

Committees dealing with SDFs, however, SDFs are +-80% complete by the time these draft SDFs are submitted to the Steering Committees and by that stage it is difficult to make or propose changes to ensure they make adequate provision for protecting agricultural land as well as for agricultural industry and seasonal housing for workers. o Municipalities require WCDoA guidance on the agricultural viability of development applications with respect to combinations of certain crops and soils. The skills of soil scientists are therefore vital in this regards • Reducing the commenting workload on SRM: Land-use management and improving both the response rate and response times of SRM: Land-use management by freeing up human resource capacity to undertake a number of pro-active measures which could include some combination of the following: o Developing the WCAPPP (see detailed discussion in this sub-section of the report) through funding the appointment of a consultant (in partnership with DEA&DP and possibly municipalities). This should assist spatial planning for the WC and constitute an improvement in pro-active long term planning to enhance the effectiveness of the SRM Land-use management sub-programme. o Review the 2019 DEAD&DP Rural Development Planning Guidelines norms for subdivisions. The WCDoA should establish new norms for subdivisions to inform DEAD&DP's revisions. Various options exist by which to calculate the minimum incomes required for farms with different commodities in different climactic regions. Potential exists for collaboration between SRM and WCDoA: Agricultural Economics Programme to conduct research on agriculture feasibility to inform the development of minimum farm sizes as informed by identifying minimum farm incomes required for different commodities in different climactic regions in the Western Cape. o Exploring the future role, and formalising the responsibilities of, SRM: LandCare in commenting on certain categories of EIAs in order to utilise the detailed local knowledge and regional capacity of LandCare. o With respect to straightforward non-impact applications (e.g. consent uses) by SRM assigning specific commenting functions to Municipalities which are supported with clear principles and guidelines as part of an SRM: Municipal MoU. Potential exists for SRM to play a role in strengthening collaboration and interaction with Municipalities in the Western Cape.	

This includes improving the awareness of municipalities of the SRM's services and building planning and land-use management capacity in Municipalities with respect to understanding agricultural issues relevant to land-use management applications. o Consider drafting provincial legislation for land use planning (agriculture). o It is very important the Municipal SDFs fully reflect the WCDoA's inputs regarding the demarcation of areas that need to be preserved for agricultural use. SRM does not have sufficient capacity to provide detailed comments when all Municipal SDFs are in the drafting stage. o Free up the SRM Land use Manager time to engage in greater application pre-consultation meetings with applicants at which aerial photos can be reviewed in order to better inform whether SRM needs to conduct site visits or not. o Make use of drones as a tool to monitor and manage our natural resources, footage will aid in better practical decisions and open a platform to become more innovative for the future.	

Table 8 Programme SRM: Disaster Risk Management: Gaps, opportunities, and constraints

WCDoA: DRM Gaps and opportunities	WCDoA: DRM Constraints
• Key DRM gaps that re are outstanding and still need to be addressed but have not due to limited human resources capacity include the following: o No disaster mitigation plans in place or actions taken other than sending out early warning information and sending out drought alerts. o No disaster preparedness actions taken in the last two years (other than veld assessments). Hazard assessments need to include other disaster risks such as river erosion, fire, and soil quality. o Inability to meet DALRRD requirements for developing contingency plans and Standard Operating Procedures for different types of disasters (e.g. droughts, floods, fires, hail, tornadoes, earthquakes, as well as for a nuclear disaster at Koeberg station etc.).	• Insufficient DRM human resources to assist the DRM Manager results in the inability of DRM to complete targets in a timely manner (and having to work extended working hours (at night and over weekends) just to keep up with the current work load) as well as lack of time to take forward pro-active initiatives to improve disaster risk reduction. • The current skills set in DRM does not include expertise in all the required areas to effectively provide disaster relief. Engineering surveys and costings need to be performed. It is difficult for SRM: DRM to rely on SRM: Engineering or SRM: LandCare to provide this support in an environment where tight deadlines exist and these staff have other competing job responsibilities and priorities. • DRM Manager post level is not necessarily aligned with the level of sub-programme budget responsibility.

WCDoA: DRM Gaps and opportunities	WCDoA: DRM Constraints
o Challenges in being able to respond to requests for information on disaster support queries. A disaster hotline and dedicated administrator is needed to perform this function. o Research is required into alternative solutions and new technologies that farmers can be using for disaster reconstruction (e.g. solar powered systems) and to provide farmers with this information. Risk assessment research is also required to develop risk profiles and understand underlying farming vulnerabilities and needs to inform appropriate interventions). o Drought support was only provided to livestock farmers and not to fruit farmers in the Western Cape. In part this is because it is too capital intensive to replace orchards. However, farmers need voucher support for other inputs such as pesticides. DARLLD published a drought document in 2019 called "Disaster Assistance Scheme Framework 2018/19 – 2020/2021 (Drought, Floods, Veld Fire, Hailstorm, Cold Spell): A Framework To Manage The Implementation of Disaster Assistance Scheme" and Agri Western Cape submitted comments on this requesting that long term crops also be included for support. • Opportunities to do more to improve disaster preparedness and reduce the risks/ impacts/ costs of disasters (in addition to addressing the above gaps) include: o Improved mitigation measures involving monitoring, reporting and information dissemination systems for sensitive resources. This could include using dashboard technology that makes information available for immediate analysis and response. o Proactive policies and incentives are needed to increase investment in disaster prevention and upscale evidence-based disaster risk reduction good practices. This needs to be informed by research into risk assessments and profiles on specific hazards.	• Lack of support /assistance for DRM by other SRM: sub programmes and other WCDoA programmes constrains the effectiveness of DRM assistance. Providing specific types of support to SRM: DRM is not specifically mentioned in the job descriptions of staff in other SRM: sub programmes. • The application, review and approval processes for disaster relief funding is a lengthy one. Due to limited resources and the need to conduct damage assessments, costing and complete funding application forms as quickly as possible, mistakes have been made in these applications resulting in information having to be corrected and re-submitted- thus delaying the process further. • Lack of access to relevant databases to determine which farmer applicants have insurance in place or not as part of the disaster relief funding application assessment process. • Lack of staff to analyse data collected from veld assessments.

WCDoA: DRM Gaps and opportunities	WCDoA: DRM Constraints
○ Provision of checklists and guidelines for farmers to use to take pro-active mitigation measures to either reduce the likelihood of disasters having an impact or reduce the size of potential impacts from disasters (possibly working in partnership with organised agriculture bodies such as Agri Western Cape, the African Farmers Association of South Africa etc.). ○ Conduct Provincial audits/ assessments to spatially and pro-actively identify priority areas requiring disaster mitigation measures (e.g. identifying areas requiring fire breaks by working with relevant fire departments, identifying those areas most vulnerable to tornadoes or hail etc.) • Reduce the administrative burden of internal administrative monitoring and reporting processes by putting in place paperless IT automated systems to monitor and manage staff, targets and deadlines. • Improve collaboration and synergies between SRM: DRM and other SRM: LandCare and SRM: Engineering as well as WCDoA: FSD. This may require job descriptions of staff in these sub-programmes including specific roles/ responsibilities/ tasks that are required by DRM and ensuring that such staff have sufficient time and other resources to assist DRM. This should be seen as an opportunity by other SRM employees to gain more experience in a different sphere of SRM. • Improved collaboration with WCDoA: Agricultural Economics programme to conduct research on the economic impacts of disasters as part of supporting SRM: DM's applications for disaster funding. • Improved administrative systems to reduce the time required for SRM: DRM to provide correspondence to farmers who were not approved for disaster support as well as to respond to complaints from farmers querying why they did not receive disaster relief and what processes were followed to decide what relief was provided to what farmers. • Information management systems to manage data on recipients of past disaster support as part of evaluating disaster support applications is needed. There is scope to design a more integrated online application process and electronic database to manage	

WCDoA: DRM Gaps and opportunities	WCDoA: DRM Constraints
farmer applications for disaster support. Currently farmers have to complete different physical paper application forms for different disasters if they have been negatively impacted by more than 1 disaster. SRM: DRM needs to go through this archive physical information records to check whether support has been previously provided to each farmers. SRM: DRM has recently developed an electronic database with information on which farmers have received disaster support in the past. SRM: DRM should consider designing an online disaster support application process for farmers which can more easily integrate electronic/ digital data with the database of previous disaster support provided. • Utilise drone technology in some cases to conduct site inspections to verify that disaster relief funding has been used for the intended purposes (this is subject to feasibility) and to reduce the time required by SRM: DRM staff to conduct site visits. Alternatively, this task needs to be allocated to SRM: LandCare staff in each District and included as part their job descriptions.	

Annexure 3: Definitions and overview of key concepts relevant to the Programme: SRM

A number of key concepts are important to this evaluation. Therefore, this section provides selected definitions of these key concepts in order to support clarity of understanding and further discussion as this evaluation process unfolds. In some cases, different definitions of the same concepts can be found in key global, national, and provincial legislation, policy and guidelines.

This section therefore sometimes provides definitions from different sources, although in some cases national legislation or policy (e.g. the Constitution) is recognised as providing the most widely accepted and authoritative definition of selected terms. For example, through the National Strategy for Sustainable Development and Action Plan 2011 – 2014 (NSSD 1) a fixed definition of sustainability and sustainable development is provided and accepted in a South African context:

> *Sustainability (or a sustainable society) is seen as the overall goal of the NSSD 1. Sustainability in this context implies ecological sustainability. In the first instance, it recognises that the maintenance of healthy ecosystems and natural resources are preconditions for human well-being. In the second instance, it recognises that there are limits to the goods and services that can be provided. In other words, ecological sustainability acknowledges that human beings are part of nature and not a separate entity.*
>
> *Sustainable development is the process that is followed to achieve the goal of sustainability. Sustainable development implies the selection and implementation of a development option, which allows for appropriate and justifiable social and economic goals to be achieved, based on the meeting of basic needs and equity, without compromising the natural system on which it is based* (Department of Environmental Affairs, 2011, p. 8).

In its "Global Trends 2030" report, the US National Intelligence Council Considers that the growing nexus among food, water and energy, in combination with climate change, is one of the four overarching megatrends which will shape the world in 2030:

> *Demand for these resources will grow substantially owing to an increase in the global population. Tackling problems pertaining to one commodity will be linked to supply and demand for the others (*US National Intelligence Council. DATE)

Any strategy that focuses on one part of the water, food, energy nexus without considering its interconnections risks serious unintended consequences" (). Land can also be added to this nexus. The SRM programme can potentially play a role in enhancing the water, food, land, energy inter-connections in terms of integrated planning for the future.

Table 9 Key concepts and definitions relevant to the scope of this SRM programme evaluation

Key concept	Selected definitions
Adaptation	The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (United Nations International Strategy for Disaster Reduction, 2009, p. 4). Comment: This definition addresses the concerns of climate change and is sourced from the secretariat of the United Nations Framework Convention on

Key concept	Selected definitions
	Climate Change (UNFCCC). The broader concept of adaptation also applies to non-climatic factors such as soil erosion or surface subsidence. Adaptation can occur in autonomous fashion, for example through market changes, or as a result of intentional adaptation policies and plans. Many disaster risk reduction measures can directly contribute to better adaptation.
Agricultural engineering	Agricultural engineering is an applied scientific discipline, often narrowly associated with farm machinery, but actually now much wider, embodying systems approaches to assess overall impacts through life cycles, and addressing key questions associated with the interface between agriculture and the environment, and global concerns for environment, food supply and people. It has contributed extensively to soil management, land development, mechanisation and automation of livestock farming, and to the efficient planting, harvesting, storage, and processing of farm commodities. This wider view has led to the subject area being increasingly referred to as agricultural and Biosystems engineering (The Institute of Agricultural Engineers, 2012, p. 12). Agricultural engineers may engage in any of the following areas: • Design of agricultural machinery, equipment, and agricultural structures • Internal combustion engines as applied to agricultural machinery • Agricultural resource management (including land use and water use) • Water management, conservation, and storage for crop irrigation and livestock production • Surveying and land profiling • Climatology and atmospheric science • Soil management and conservation, including erosion and erosion control • Seeding, tillage, harvesting, and processing of crops • Livestock production, including poultry, fish, and dairy animals • Waste management, including animal waste, agricultural residues, and fertilizer runoff • Food engineering and the processing of agricultural products • Basic principles of circuit analysis, as applied to electrical motors • Physical and chemical properties of materials used in, or produced by, agricultural production • Bioresource engineering, which uses machines on the molecular level to help the environment. • Crop processing and storage which deals with post-harvest handling of crops Source: https://en.wikipedia.org/wiki/Agricultural_engineering
Agricultural land	1. Means all land in the jurisdiction of the Republic, excluding land – (a) in a proclaimed township; (b) with regard to which an application for declaration as a township had been submitted in accordance with

Key concept	Selected definitions
	applicable township establishment legislation prior to the date of commencement of the proposed Bill, provided that such application is approved; (c) which, immediately prior to the date of commencement of the proposed Bill, was formally zoned for non-agricultural purposes by any sphere of government or any public entity but subjected to specified conditions at the time of the rezoning; or (d) which the Minister, after consultation with other relevant Ministers and Members of Executive Council (MEC's) concerned, within the provisions established in the proposed Bill, excludes by means of a notice in the Gazette (Department of Agriculture, Forestry and Fisheries, 2016, p. 8). 2. Agricultural land" means land outside the physical outer edge of the existing urban area, excluding land declared as a protected area or land that is zoned for a purpose other than agriculture (Western Cape Government, 2019, p. 75). 3. Agricultural land" means land outside the physical edge of the existing urban area, excluding— 1. land declared as a protected area in terms of the National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003); or 2. land that was immediately before the commencement of the Act zoned for a purpose other than agriculture (Department of Agriculture, Forestry and Fisheries, 2016, p. 4).
Agricultural potential	*i. is a measure of potential productivity per unit area and unit time achieved with specified management inputs; and* *ii. for a given crop or veld type and level of management, is largely determined by the interaction of climate, soil and terrain* (Department of Agriculture, Forestry and Fisheries, 2016, p. 4). *(Productivity as an indication of the agricultural potential for a given crop under a management level and for an identified portion of land as being dependent on precipitation, temperature, soil conditions, terrain and crop characteristics* (Schoeman & Scotney, 1987, p. 160).
Agroecology	*Agro-ecology is a form of agriculture when and where properly implemented provides all the solutions for soil fertility, natural parasites, pest and weed control, and the potential hazards associated with continuous irrigation. The principle of agro-ecology is that a healthy soil enables healthy pastures and crops. Agro-ecological practices use sustainable grazing, in contrast to the common practice in South Africa of over-grazing, a consequence of breeding for money rather than to produce to keep the land sustainable (DALRRD. 2015. APAP: 119).* *Agroecology is the integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic, and social. It's transdisciplinary in that it values all forms of knowledge and experience in food system change. It's participatory in that it requires the involvement of all stakeholders from the farm to the table and everyone in between. And it is action-oriented because it confronts the economic and political power structures of the current industrial food system with alternative*

Key concept	Selected definitions
	social structures and policy action. The approach is grounded in ecological thinking where a holistic, systems-level understanding of food system sustainability is required (Gliessman, 2018, p. 599).
Agro-ecosystem	"Agro-ecosystem" means a dynamic association of crops, pastures, veld types, livestock, other fauna and flora, atmosphere, soils, and water that is contained within larger landscapes that include terrain features, drainage networks and rural communities (Department of Agriculture, Forestry and Fisheries, 2016, p. 5).
Agro-processing	Entails changing the form of a product originating from agriculture, forestry and fisheries (Department of Trade and Industry (The Department of Trade and Industry, 2017, p. 13). The agro-processing industry covers a broad area of postharvest activities, comprising artisanal, minimally processed and packaged agricultural raw materials, the industrial and technology-intensive processing of intermediate goods and the fabrication of final products derived from agriculture (Wilkinson & Rocha, 2009, p. 46).
Capacity	A combination of all the strengths and resources available within a community, society or organisation that can reduce the level of risk, or the effects of a disaster. Capacity may include physical, institutional, social or economic means as well as skilled personnel or collective attributes such as leadership and management (Western Cape Government, 2010, p. 3).
Capacity building	Efforts aimed to develop human skills or infrastructures within a community or organisation needed to reduce the level of risk. It may also include the development of institutional, financial, political and other resources, such as technology, at different levels and sectors of the society (Western Cape Government, 2010, p. 3).
Climate change	"Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations, 1992, p. 1). A change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2014, p. 120).
Climate-smart agriculture (CSA)	Agricultural development strategies have shifted from promoting one-size-fits-all technologies aimed at increasing productivity, to advocating for improved agricultural practices that account for both livelihood and environmental outcomes. The most recent approach to an integrated development agenda is 'climate-smart agriculture' (CSA). Agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (GHGs) (mitigation), and enhances achievement of national food security and development goals (Food and Agriculture Organization of the United Nations, 2010, p. 3).

Key concept	Selected definitions
	Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: • Sustainably increasing agricultural productivity and incomes; • Adapting and building resilience to climate change; • Reducing and/or removing greenhouse gas emissions, where possible. CSA is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA refers to agricultural systems that increase food security in the face of climate change, enhance adaptive capacity of farmers to the impacts of climate change, and mitigate climate change where possible (Bogdanski A, Dubois O, Jamieson C, Krell R: Making Integrated Systems Work for People and Climate. Rome; 2010:1–136.) The concept of CSA is evolving and there is no one-size-fits-all blueprint for how it might be pursued (Food and Agricultural Organization of the United Nations (FAO), 2020). A 'Global Alliance for Climate-Smart Agriculture' (GACSA) was recently launched at the United Nations Secretary Generals' Climate Summit in September 2014 with the goal of helping 500 million smallholder farmers practice CSA. Recently, the Green Climate Fund (GCF) named CSA in Africa and Asia as one of its five priority investment areas, and the Global Environmental facility (GEF) has a focal area on CSA and food security in Africa.
Conservation Agriculture (CA)	Conservation Agriculture (CA) is a farming system that promotes maintenance of a permanent soil cover, minimum soil disturbance (i.e. no tillage), and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production. CA is bed on three principles: 1. Minimum mechanical soil disturbance (i.e. no tillage) through direct seed and/or fertilizer placement. 2. Permanent soil organic cover (at least 30 percent) with crop residues and/or cover crops. 3. Species diversification through varied crop sequences and associations involving at least three different crops (Food and Agricultural Organization of the United Nations (FAO), 2020). Conservation Agriculture is "an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. It is characterized by three linked principles, namely, continuous minimum mechanical soil disturbance; permanent organic soil cover; and diversification of crop species grown in sequences and/or associations" (FAO 2013, p. 549). Only recently has CA been promoted on the basis of its climate adaptation and

Key concept	Selected definitions
	mitigation benefit. The water and soil-conservation effects of CA help to stabilize yields against extreme weather events. Under certain conditions CA may contribute to climate change mitigation through carbon sequestration and reduced GHG emissions (Richards and Sander 2014). Conservation agriculture is an approach to agricultural development that form part of CSA, but where CA has a focus on sustainable soil management CSA focuses on food security and climate change. https://csa.guide/csa/key-terms
Contingency planning	The forward planning process for an event that may or may not occur, in which scenarios and objectives are agreed, managerial and technical actions defined, and potential response systems put in place to prevent, or respond effectively to, an emergency situation (Western Cape Government, 2010, p. 4).
Development management	The management of land development on a provincial and municipal level through mechanisms such as planning regulations, by-laws, zoning schemes, building plan applications etc. (Western Cape Government, 2019, p. 75).
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of the disaster risk. (United Nations International Strategy for Disaster Reduction, 2009, p. 9). Comment: Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.
Disaster impact	Disaster impact is the total effect, including negative (e.g. economic losses) effects and positive (e.g. economic gains) effects, of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include injuries, disease and other negative effects on human physical, mental and social well-being. For the purpose of the scope of the Sendai framework (paragraph 15) the following terms are also Considered: • Small-scale disaster: A type of disaster only affecting local communities which require assistance beyond the affected community. • Large-scale disaster: A type of disaster affecting a society, which requires national or international assistance. • Frequent and infrequent disasters: depend on the probability of occurrence and the return period of a given hazard and its impacts. The impact of frequent disasters could be cumulative, or become chronic for a community or a society.

Key concept	Selected definitions
	• A slow-onset disaster is defined as one that emerges gradually over time. Slow-onset disasters could be associated with e.g. drought, desertification, sea level rise, epidemic disease. • A sudden-onset disaster is one triggered by a hazardous event that emerges quickly or unexpectedly. Sudden-onset disasters could be associated with e.g. earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, transport accident (United Nations International Strategy for Disaster Reduction, 2009, p. 13).
Disaster Operations Centre	A fully equipped dedicated facility within the disaster management centre of a particular sphere. Such a facility must be capable of accommodating any combination of emergency and essential services representatives, including all relevant role players and stakeholders identified in response and recovery plans for the purposes of multidisciplinary strategic management of response and recovery operations, when a local, provincial or national disaster occurs or is threatening to occur (Western Cape Government, 2010, p. 4).
Disaster Prevention	The outright avoidance of adverse impacts of hazards and related disasters (United Nations International Strategy for Disaster Reduction, 2009, p. 22). Comment: Prevention (i.e. disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high risk zones, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake. Very often the complete avoidance of losses is not feasible and the task transforms to that of mitigation. Partly for this reason, the terms prevention and mitigation are sometimes used interchangeably in casual use.
Disaster Risk Governance	The system of institutions, mechanisms, policy and legal frameworks and other arrangements to guide, coordinate and oversee disaster risk reduction and related areas of policy Annotation: Good governance needs to be transparent, inclusive, collective, and efficient to reduce existing risks and avoid creating new ones.
Disaster Risk Management	Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses (United Nations International Strategy for Disaster Reduction, 2009, p. 10). The systematic process of using administrative decisions, organisation, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to prevent or to limit (mitigation and preparedness) adverse effects of hazards (Western Cape Government, 2010). Annotation: Disaster risk management actions can be distinguished between prospective disaster risk management, corrective disaster risk management and compensatory disaster risk management, also called residual risk management" (United Nations Office for Disaster Risk Reduction (UNISDR), 2016). **Prospective risk management** activities address and seek to avoid the development of new or increased disaster risks. They focus on addressing risks

Key concept	Selected definitions
	that may develop in future if risk reduction policies are not put in place; examples are better land-use planning or disaster resistant water supply systems. **Corrective risk management** activities address and seek to remove or reduce disaster risks which are already present and which need to be managed and reduced now. Examples are the retrofitting of critical infrastructure or the relocation of exposed populations or assets. **Compensatory risk management** activities strengthen the social and economic resilience of individuals and societies in the face of residual risk that cannot be effectively reduced. They Include preparedness, response and recovery activities, but also a mix of different financing instruments, such as national contingency funds, contingent credit, insurance and reinsurance, and social safety nets. **Community Based disaster risk management** promotes the involvement of affected communities in disaster risk management at the local level. This includes community assessments of hazards, vulnerabilities and capacities, and their involvement in planning, implementation, monitoring and evaluation of local action for disaster risk reduction (United Nations Office for Disaster Risk Reduction (UNDRR), 2020). South African National definition: Disaster Management Act, 2002 (Act No. 57 of 2002) Disaster Risk Management is defined, as: "The systematic process of using administrative decisions, organisation, operational skills management and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to prevent or to limit (mitigation and preparedness) adverse effects of hazards." (Disaster Management Act, No. 57 of 2002, 2002, p. 112). Structural measures: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard resistance and resilience in structures or systems; Non-structural measures: Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education. Comment: Common structural measures for disaster risk reduction include dams, flood levies, ocean wave barriers, earthquake-resistant construction, and evacuation shelters. Common non-structural measures include building codes, land use planning laws and their enforcement, research and assessment, information resources, and public awareness 29 programmes. Note that in civil and structural engineering, the term "structural" is used in a more restricted sense to mean just the load-bearing structure, with other parts such as wall cladding and interior fittings being termed non-structural (United Nations Office for Disaster Risk Reduction (UNDRR), 2020).
Disaster risk management plans	Disaster risk management plans set out the goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives. They should be guided by the Sendai Framework and Considered and coordinated within relevant development plans, resource allocations and programme activities. National level plans need to be specific to each level of administrative responsibility and adapted to the different social and

Key concept	Selected definitions
Disaster risk reduction management plans and strategies	geographical circumstances that are present. The time frame and responsibilities for implementation and the sources of funding should be specified in the plan. Linkages to sustainable development and climate change adaptation plans should be made where possible (United Nations Office for Disaster Risk Reduction (UNDRR), 2020). Disaster risk reduction strategies and plans define goals and objectives across different timescales and with concrete targets, indicators and time frames. In line with the Sendai Framework, these should be aimed at preventing the creation of risk, the reduction of existing risk and the strengthening of economic, social, health and environmental resilience. A global, agreed policy of disaster risk reduction is set out in the United Nations' endorsed "Sendai Framework for Disaster Risk Reduction 2015-2030", adopted in March 2015, whose expected outcome over the next 15 years is: "The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" (United Nations Office for Disaster Risk Reduction (UNDRR), 2020).
Disaster Risk Reduction	According to the Disaster Management Amendment Act 16 of 2015; Disaster Risk Reduction is defined as: '''disaster risk reduction' means either a policy goal or objective, and the strategic and instrumental measures employed for— (a) anticipating future disaster risk; (b) reducing existing exposure, hazard or vulnerability; and (c) Improving resilience;'' (Disaster Management Amendment Act, No. 16 of 2015, 2015, p. 6). Comment: There are four disaster risk reduction core areas that are critical for Climate Smart Agriculture (CSA) (FAO. 2017): 1. Multi-hazard risk assessments 2. Disaster risk governance 3. Investments in disaster risk reduction, and 4. Emergency preparedness, response and recovery. The conceptual framework of elements Considered with the possibilities to minimise vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development (Western Cape Government, 2010)
Drought	Drought is not easily defined and often depends on who you speak to. The South African Weather Service defines drought on the basis of the degree of dryness in comparison to normal or average amounts of rainfall for a particular area or place and the duration of the dry period. This is what is termed a meteorological drought. Less than 75% of normal rainfall is regarded as a severe meteorological drought but a shortfall of 80% of normal rainfall will cause crop and water shortages which will ultimately affect social and economic factors. Normal rainfall for a particular place is calculated over a 30-year period using for example rainfall figures from 1961 to 1990. Other climatic factors such as high temperature, high wind, low soil moisture and low relative humidity can significantly aggravate the severity of drought conditions and these additional

Key concept	Selected definitions
	factors should also be taking into account (SA Weather Services. https://www.weathersa.co.za/home/climateques
Early warning	Timely and effective information, through identified institutions, that allows individuals, households, areas and communities exposed to a hazard to take action to avoid or reduce the risk and prepare for effective response (Western Cape Government, 2010, p. 4).
Early warning system	An interrelated and connected set of hazard monitoring, risk assessment, communication and preparedness activities that enable individuals, communities, governments, businesses and others to take timely action to reduce their risks in advance of hazardous events. Annotations: Effective "end-to-end" and "people-centred" early warning system comprises four interrelated key elements: 1. Risk knowledge based on the systematic collection of data and risk assessments; 2. Detection, monitoring, analysis and forecasting of the hazards and possible consequences; 3. Dissemination and communication of authoritative, timely, accurate and actionable warnings and associated information on likelihood and impact; and 4. Preparedness and local capabilities to respond to the warnings received. These four interrelated components need to be coordinated within and across sectors and multiple levels for the system to work effectively. Failure in one component or lack of coordination across them could lead to the failure of the whole system. Multi-hazard early warning systems cover a range of hazards and impacts. They are designed to be used in multi-hazard contexts where hazardous events may occur simultaneously or cumulatively over time, and taking into account the potential interrelated effects. A multi-hazard early warning system increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated and accurate hazards identification and monitoring (United Nations Office for Disaster Risk Reduction(UNDRR), 2016, p. 17). Even when climatic extremes do not occur, the uncertainty of climate-related risk can inhibit the adoption of CSA practices (Coffey et al. 2015). Systems capable of providing early warnings of extreme events can limit the negative impacts, and give farmers the confidence to invest in CSA. An early warning system (EWS) may be defined as a system to generate and dissimilate timely and meaningful warning information about possible extreme events or disasters and their consequences. In a slow-onset climate stress that threatens food security, such as drought, an EWS that combines remote sensing, agrometeorological monitoring, and seasonal climate prediction can generally give a good indication of increased risk long before harvest. The greatest barriers of establishing effective early warning systems are tied to decision-making choices, rather than the quality of climate information itself. As a result, improving communication and processes of decision-making are key to maximizing the benefit of these systems. https://csa.guide/csa/key-terms
Ecological infrastructure	Ecological infrastructure refers to naturally functioning ecosystems that generate or deliver valuable services to people, e.g. water catchments, wetlands, riparian zones, coastal dunes, kelp beds or spawning grounds. Ecological infrastructure

Key concept	Selected definitions
	consists of a network of interconnected structural elements in the landscape and seascape (Department of Rural Development and Land Reform, 2019, p. 16).
Economic loss	Total economic impact that consists of direct economic loss and indirect economic loss. Direct economic loss: the monetary value of total or partial destruction of physical assets existing in the affected area. Direct economic loss is nearly equivalent to physical damage. Indirect economic loss: a decline in economic value added as a consequence of direct economic loss and/or human and environmental impacts. Annotations: Example of physical assets that are the basis for calculating direct economic loss include homes, schools, hospitals, commercial and governmental buildings, transport, energy, telecommunications infrastructures and other infrastructure; business assets and industrial plants; production such as crops, livestock and production infrastructure. They may also encompass environmental assets and cultural heritage. Direct economic loss usually happens during the event or within the first few hours after the event and are often assessed soon after the event to estimate recovery cost and claim insurance payments. These are tangible and relatively easy to measure. Indirect economic loss includes micro-economic impacts (e.g. revenue declines owing to business interruption), meso-economic impacts (e.g. revenue declines owing to impacts on natural assets, interruptions to supply chains or temporary unemployment) and macroeconomic impacts (e.g. price increases, increases in government debt, negative impact on stock market prices, and decline in GDP). Indirect losses can occur inside or outside of the hazard area and often with a time lag. As a result they may be intangible or difficult to measure (United Nations Office for Disaster Risk Reduction (UNISDR), 2016, p. 9).
Ecosystem-based adaptation	"Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change (United Nations Convention on Biological Diversity (CBD) , 2009, p. 6). Ecosystem-based Adaptation, involving the conservation, sustainable management and restoration of ecosystems are cost-effective solutions that can help people adapt to the impacts of climate change. Examples of such nature-based solutions to climate change include sustainable agriculture, integrated water resource management and sustainable forest management. Ecosystem-based adaptation is viewed as one of the principle ways in which countries can respond to climate change. The concept is scientifically sound and implementation often produces a broad set of ecological, social and economic co-benefits. Yet uptake of the concept varies Considerably around the globe. In certain countries, for example, South Africa, the concept has gained significant traction while in other regions there is little uptake of idea.
Ecosystem Services	The beneficial services that nature provide to people. Ecosystem services are typically grouped into four broad categories: (1) *provisioning,* including the production of food and water; (2) *regulating,* including the control of climate and disease; (3) *supporting,* including nutrient cycles and oxygen production; and (4) *cultural,* including spiritual and recreational benefits (Department of

Key concept	Selected definitions
	Rural Development and Land Reform, 2019, p. 16).
Focal/nodal point	An individual responsible for co-ordinating the disaster risk management responsibilities and arrangements of a national, provincial or municipal organ of state or a municipal entity. The term is also used to refer to an individual with similar responsibilities in an NGO or the private sector (Western Cape Government, 2010, p. 4).
Fourth Industrial Revolution	The fourth industrial revolution, a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives (Xu & Kim, 2018, p. 1).
Fragmentation of agricultural land	Fragmentation of agricultural land" means the subdivision or change in the scheduled use of agricultural land that reduces the economic, environmental, social and logistical efficiency and viability of a farming system and agro-ecosystem (Department of Agriculture, Forestry and Fisheries, 2016, p. 6).
Green economy	A green economy is defined as low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services (United Nations Environment Programme, 2020).
Green growth	Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. Green growth is not a replacement for sustainable development. Rather, it provides a practical and flexible approach for achieving concrete, measurable progress across its economic and environmental pillars, while taking full account of the social consequences of greening the growth dynamic of economies. The focus of green growth strategies is ensuring that natural assets can deliver their full economic potential on a sustainable basis. That potential includes the provision of critical life support services – clean air and water, and the resilient biodiversity needed to support food production and human health. Natural assets are not infinitely substitutable and green growth policies take account of that (Organisation for Economic Co-operation and Development, 2020).
Hazard	A potentially damaging physical event, phenomenon and/or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability (Western Cape Government, 2010, p. 4).
Hazard analysis	Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour (Western Cape Government, 2010, p. 4).
High potential agricultural land	The best land available for, suited to and capable of consistently producing optimum yields of a wide range of agricultural products (food, feed, forage,

Key concept	Selected definitions
	fibre and oilseed), with minimum damage to the environment (Western Cape Government, 2019, p. 76).
Integrated Water Resource Management	Integrated Water Resources Management (IWRM) has been defined by the Technical Committee of the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." IWRM is based on the three principles: social equity, economic efficiency and environmental sustainability. Considering these principles means answering the following questions: 1. How will my decision/ action affect access for other users to water or the benefits from its use? 2. Will my decision/ action result in the 'most efficient use of the available financial & water resources? 3. How will my decision/ action affect the functioning of natural systems? Social equity means ensuring equal access for all users (particularly marginalised and poorer user groups) to an adequate quantity and quality of water necessary to sustain human well- being. The right of all users to the benefits gained from the use of water also needs to be Considered when making water allocations. Benefits may include enjoyment of resources through recreational use or the financial benefits generated from the use of water for economic purposes. Economic Efficiency means bringing the greatest benefit to the greatest number of users possible with the available financial and water resources. This requires that the most economically efficient option is selected. The economic value is not only about price – it should Consider current and future social and environmental costs and benefits. Ecological Sustainability requires that aquatic ecosystems are acknowledged as users and that adequate allocation is made to sustain their natural functioning. Achieving this criterion also requires that land uses and developments that negatively impact these systems are avoided or limited. Water allocation plans: As water is a shared resource, water rights should be flexible in terms of allocation in order to accommodate changes. Preparing a master plan that reflects individual sector plans facilitates the coordination among various sectors and advocates the most appropriate utilization of a basin's resource (IWA Publishing, 2020).
Land degradation	According to FAO (2015), "Land degradation has a wider scope than both soil erosion and soil degradation in that it covers all negative changes in the capacity of the ecosystem to provide goods and services". Common drivers are deforestation, heavy grazing and unsustainable soil management (e.g. extensive ploughing, irrigation and use of inorganic fertilizer). Land degradation is a major threat to productivity, biodiversity, ecosystem stability and eventually

Key concept	Selected definitions
	food-security and society's ability to function (GEF 2013). The impacts of land degradation extend far beyond local or regional scales and once degraded, it is difficult to revitalize land once again. https://csa.guide/csa/key-terms
Land reform	The process of correcting the historical imbalances in (1) *ownership* of land, and (2) *access* to land. It entails three types of intervention by the State, *viz.* (1) *land restitution,* meaning the redress of wrongs committed during the colonial and Apartheid eras; (2) *land redistribution,* meaning the provision of land for residential and economic purposes to those who do not have the means to access land); and (3) *tenure reform,* meaning the provision of security of tenure benefits (Department of Rural Development and Land Reform, 2019, p. 17).
Land-use planning	The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including Consideration of long term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses (United Nations International Strategy for Disaster Reduction, 2009, p. 19). Comment: Land-use planning is an important contributor to sustainable development. It involves studies and mapping; analysis of economic, environmental and hazard data; formulation of alternative land-use decisions; and design of long-range plans for different geographical and administrative scales. Land-use planning can help to mitigate disasters and reduce risks by discouraging settlements and construction of key installations in hazard-prone areas, including Consideration of service routes for transport, power, water, sewage and other critical facilities. "Land use planning" means spatial planning and development management (Western Cape Department of Agriculture, 2019, p. 76).
LandCare	LandCare is a specific model, or approach, to community based natural resource management, where collaborative environmental planning, co-management and community-based planning are a 'bottom-up' alternative to conventional 'top-down' approaches (Prager & Vanclay, 2010). LandCare is essentially a concept involving a process of participation that focuses on land resource management through the promotion of sustainable use practices. LandCare involves 'local people taking local action in their local area' to achieve sustainable land use and management. LandCare includes individual and group activities directed at on-ground action. It also provides an opportunity for local landholders to take a leading and responsible role in planning and undertaking activities to conserve their most important assets. LandCare encourages community interest and action through the formation of LandCare groups. LandCare groups assess local problems, determine priorities and undertake action. Local leadership and initiative leads to a greater understanding of the issues. In this way, the local communities become owners of the solutions (Department of Agriculture, Forestry and Fisheries, 2020).
Land degradation	Land degradation is defined as the reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from a combination of pressures, including land use and management practices. Land Degradation Neutrality (LDN) is defined as a state whereby the amount and quality of land resources necessary to support ecosystem functions and

Key concept	Selected definitions
	services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems (decision 3/Conference Of Parties (COP)12) (Food and Agriculture Organization of the United Nations, 2020).
Mitigation	The lessening or minimising of the adverse impacts of a hazardous event. Annotation: The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. It should be noted that in climate change policy, "mitigation" is defined differently, being the term used for the reduction of greenhouse gas emissions that are the source of climate change (United Nations Office for Disaster Risk Reduction (UNISDR), 2016, p. 11). Mitigation is a human intervention to reduce or prevent emission of greenhouse gases (e.g. by using renewable energies, improve energy efficiency, changing management practices or consumer behaviour) or to protect (e.g. forests and oceans) or create carbon sinks (e.g. through conservation agriculture or agroforestry). https://csa.guide/csa/key-terms
Monitoring	A system of checking and observing to ensure that the correct procedures and practices are being followed (Western Cape Government, 2010, p. 5).
Moral hazard	A form of perverse incentive that may arise under conditions of asymmetric information between national government and provincial and local governments. This could create a situation where provincial governments and municipalities deliberately under-budget on certain activities (such as disaster risk reduction), relying on national government to bail them out in the form of disaster recovery assistance once a disaster has occurred (Western Cape Government, 2010, p. 5).
Municipal (and national and provincial) spatial development framework	The national and provincial spheres of government and each municipality must prepare spatial development frameworks that: a) interpret and represent the spatial development vision of the responsible b) sphere of government and competent authority; c) are informed by a long-term spatial development vision statement and plan; d) represent the integration and trade-off of all relevant sector policies and plans; e) guide planning and development decisions across all sectors of government; f) guide a provincial department or municipality in taking any decision or g) exercising any discretion in terms of this Act or any other law relating to h) spatial planning and land use management systems; i) contribute to a coherent, planned approach to spatial development in the j) national, provincial and municipal spheres;

Key concept	Selected definitions
	k) provide clear and accessible information to the public and private sector and l) provide direction for investment purposes; m) include previously disadvantaged areas, areas under traditional leadership, n) rural areas, informal settlements, slums and land holdings of state-owned o) enterprises and government agencies and address their inclusion and p) integration into the spatial, economic, social and environmental objectives of q) the relevant sphere; r) address historical spatial imbalances in development; s) identify the long-term risks of particular spatial patterns of growth and t) development and the policies and strategies necessary to mitigate those risks; u) provide direction for strategic developments, infrastructure investment, v) promote efficient, sustainable and planned investments by all sectors and w) indicate priority areas for investment in land development; x) promote a rational and predictable land development environment to create trust and stimulate investment; y) take cognisance of any environmental management instrument adopted by the relevant environmental management authority; z) give effect to national legislation and policies on mineral resources and sustainable utilisation and protection of agricultural resources; and aa) Consider and, where necessary, incorporate the outcomes of substantial public engagement, including direct participation in the process through public meetings, public exhibitions, public debates and discourses in the media and any other forum or mechanisms that promote such direct involvement. Source: 2013 Spatial and Land Use Management Act.
National spatial development framework	A long-term national spatial planning instrument with a long-term horizon that (1) is mandated by the Spatial Planning and Land Use Management Act, 2013 (SPLUMA), (2) has to be aligned with the National Development Plan (NDP), and (3) is adopted by Cabinet as official national spatial development policy for implementation throughout the country. As such, it provides (1) an overarching spatial development framework including a set of principle-driven spatial investment and development directives for all three spheres and sectors of government, meaning 'where, when, what type, and how much to invest and spend throughout the country'; and (2) a set of strategic spatial areas of national importance from an ecological, social, economic and/or information communications technology (ICT) or movement infrastructure perspective, to be targeted by both government and the private sector in the pursuit of strategic national development objectives, or to avert national crises (Department of Rural Development and Land Reform, 2019, p. 18).
Natural hazards	Natural processes or phenomena, such as extreme climatological, hydrological or geological processes, that may constitute a damaging event. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent,

Key concept	Selected definitions
	speed of onset, spatial dispersion and temporal spacing (Western Cape Government, 2010, p. 5).
Precision agriculture	During the 1980s, precision agriculture evolved from advances in soil sampling, statistics, and computing power, which highlighted the connection between soil variability and crop yield (Robert 2002; Oliver 2013; Franzen and Mulla 2016; Mulla and Khosla 2016). Precision agriculture is defined as a set of farmer practices to achieve agricultural sustainability based on the four Rs: right application, right amount, right time, and right place (Daughtry, Hunt, & Craig, 2018, p. 2).
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations (Western Cape Government, 2010, p. 5).
Prevention	Actions to provide outright avoidance of the adverse impact of hazards and means to minimise related environmental, technological and biological disasters (Western Cape Government, 2010, p. 5).
Priority disaster risk	A risk identified as a priority through a scientific evaluative process in which different disaster risks are evaluated and ranked according to criteria determined by the broader socio-economic and environmental context in which the risk is located. The process of determining these criteria should be consultative, and involve scientific, civil society and government stakeholders (Western Cape Government, 2010, p. 5).
Public awareness	The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. Public awareness activities foster changes in behaviour leading towards a culture of risk reduction (Western Cape Government, 2010, p. 6).
Rapid-onset disasters	A disaster caused by natural events, such as earthquakes, floods, storms, fires and volcanic eruptions. Although such events are more sudden, the impact can also be heightened by underlying problems associated with poverty (Western Cape Government, 2010, p. 6).
Recovery	Decisions and actions taken immediately after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures (Western Cape Government, 2010, p. 6).
Relief	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can include the provision of shelter, food, medicine, clothing, water, etc. (Western Cape Government, 2010, p. 6).
Resilience	The capacity of a system, community or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organising itself to increase this capacity for learning from past disasters for better future protection and to improve disaster risk reduction measures (Western Cape Government, 2010, p. 6).
Response	Measures taken during or immediately after a disaster in order to provide assistance and meet the life preservation and basic subsistence needs of those

Key concept	Selected definitions
	people and communities affected by the disaster. These measures can be of immediate, short-term or protracted duration (Western Cape Government, 2010, p. 6).
Response management system	A system designed to provide a systematic approach to ensure the effective co-ordination and management of operational, tactical and strategic response efforts. It involves the combination of resources and procedures in a common organisational structure for the purposes of achieving rapid and effective response (Western Cape Government, 2010, p. 6).
Risk assessment	A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend (United Nations International Strategy for Disaster Reduction, 2009, p. 26). Comment: Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.
Risk (disaster risk)	The probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, disrupted economic activity or environmental damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Conventionally risk is expressed as follows: Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability (Western Cape Government, 2010, p. 6).
Rural areas	"Rural areas" means all areas outside of the physical outer edge of existing built-up areas and settlements, no matter how small; i.e. all non-urban areas outside of settlements (Western Cape Department of Agriculture, 2019, p. 76).
Rural development	The process of improving the quality of life and economic well-being of people living in a rural area, by planned interventions in the area in (1) the ownership and use of land, (2) the provision, maintenance and upgrading of infrastructure and social services, and (3) the type and intensity of economic activities (Department of Rural Development and Land Reform, 2019, p. 18). "rural development" is a multi-dimensional term, whose meaning encompasses: improved and sustainable provision of services to rural communities; enhanced opportunities for rural income generation and local economic development; improving the functionality and integrity of ecosystems; upgraded physical infrastructure; social cohesion and physical security within rural communities; upholding rural cultural values and lifestyles; active representation in local political processes; and provision for the vulnerable (Adapted from RSA Integrated Sustainable Rural Development Strategy (ISRDS) 2000) (Western Cape Government, 2019, p. 76).
Rural edge	A line that is used to delineate a systemically-integrated area/region that has distinct rural qualities that need to be protected from 'intruding' uses that may disrupt or destroy these qualities. Typically, the delineation would be accompanied by (1) a description of the kinds of activities that are permitted within the area/region, and (2) the procedures to apply for uses that are not

Key concept	Selected definitions
	specified as such. The line may have coordinates and be statutory, meaning it has binding legal power, or be seen as a soft or 'fuzzy line', meaning its exact coordinates are not defined, and it is to be used in a planning and policy sense and not as hard, impenetrable physical line (Department of Rural Development and Land Reform, 2019, p. 19).
Significant event	An event which does not necessarily justify the classification of a disaster but is of such a magnitude or importance that extraordinary measures are required to deal with it effectively. The term can also be applied to a situation where multiple single emergencies are occurring simultaneously within a given jurisdiction, placing undue demands on scarce resources. Together, these events may constitute a disaster. A significant event can also represent a new or unexpected shift in hazard, vulnerability or risk patterns, calling for closer investigation in order to better anticipate future changes in disaster risk (Western Cape Government, 2010, p. 6).
Slow-onset disasters	Disasters which result when the ability of people to support themselves and sustain their livelihoods slowly diminishes over time. Slow-onset disasters usually take several months or years to reach a critical phase (Western Cape Government, 2010, p. 6).
Soil management	According to FAO, soil management is "an integral part of land management and may focus on differences in soil types and soil characteristics to define specific interventions that are aimed to enhance the soil quality for the land use selected" (FAO 2015). Richer soils can improve agricultural productivity while requiring fewer inputs, sequester atmospheric carbon, and maintain ecosystem functions such as water infiltration. According to FAO (2013), good management practices include no-tillage, integrated soil fertility management and precision nitrogen management. https://csa.guide/csa/key-terms
Strategic water source areas	Strategic Water Source Areas (SWSAs) can be described as 'water factories' that support growth and development needs that are often a long distance away from the SWSAs themselves. These areas contribute significantly to the overall surface and ground water supply of the country. While Strategic Water Source Areas have been identified by the Water Research Commission (2015), they are not formally protected (Department of Rural Development and Land Reform, 2019, p. 19).
Stressed catchments	'Water stress' occurs when the amount of water used exceeds 10% of renewable resources. Water stress depends on a range of factors and is not simply a shortfall in water availability versus requirement. Water deficits will not be experienced the same over an entire Water Management Area, nor at all times. In some cases, the deficits do not imply that consumptive use exceeds the available water, but that the allowances made for the implementation of the ecological component of the reserve cannot be met fully at present levels of use. Stressed catchments are also impacted upon by 'water demand/requirement', which refers specifically to the 'beneficial, effective and efficient use of water', which can be improved through, for example, a reduction in water losses (Department of Rural Development and Land Reform, 2019, p. 19).
Sustainable agriculture	The FAO notes that in the past, sustainable agriculture had been defined in the past primarily along environmental criteria. If the soil was bad, or if water was not managed well, then a farm might have been Considered unsustainable. In recent years, however, there has been a realization that being sustainable reaches much further, to include economic and social dimensions, and putting farmers in the centre. If a farm is not economically sound or not resilient to

Key concept	Selected definitions
	external shocks, or if the well-being of those working on a farm are not Considered, then a farm cannot be sustainable. National Definition (DALRRD. 2016. Version 2.1 Conservation and Preservation of Agricultural Land Bill): sustainable agriculture" means – (a) farming practices that – (i) conserve land, water, plant and animal genetic resources; and (ii) are environmentally non-degrading, technically appropriate, economically viable, and socially acceptable; and (b) an integrated system of plant and animal production practices having an agroecosystem site-specific application that complements ecological and biodiversity conservation and meets present needs without compromising the ability to meet future needs to – (i) satisfy human food and fibre needs; (ii) enhance environmental quality and the natural resource base upon which the agricultural economy depends; (iii) make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; (iv) sustain the viability of a farming unit; and (v) enhance the quality of life for farmers and society as a whole. The WCG's 2019 Land-use planning Guidelines for Rural Land Areas notes that "The basis of sustainable agriculture, is implementing agricultural activities, that combine technology, policies and activities to integrate natural resources with socio-economic principles by: • Productivity: Maintaining or enhancing services and the biological productivity of the land. • Security: Reducing all levels of production risk to ensure security (socio-economic and natural resources). • Protection: Maintaining the quality and functions of natural resources through the protection of the potential of the soil and water quality. • Viability: Ensuring economically viability. • Acceptability: Implementing actions that are socially acceptable and responsible. A good balance must be found between these five principles, as the basic 'pillars' on which sustainable land management for agriculture must be constructed (Western Cape Government, 2019, p. 30). Khwidzhili and Worth (2016) propose five pillars of sustainable agriculture: • Maintaining and increasing biological productivity; • Decreasing the level of risk to ensure larger security; • Protecting the quality of natural resources; • Ensuring agricultural production is economically viable; and • Ensuring agricultural production is socially acceptable and acceptance.

Key concept	Selected definitions
Sustainable agricultural development	FAO defines sustainable agricultural development as "the management and conservation of the natural resource base, and the orientation of technological and institutional change so as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development [...] conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (FAO 1997). https://csa.guide/csa/key-terms
Sustainable agricultural mechanisation	Mechanization covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortages, improves productivity and timeliness of agricultural operations, improves the efficient use of resources, enhances market access and contributes to mitigating climate related hazards. Sustainable mechanization Considers technological, economic, social, environmental and cultural aspects when contributing to the sustainable development of the food and agricultural sector (Food and Agriculture Organization of the United Nations (FAO), 2020).
Sustainable development	Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. World Commission on Environment and Development (WCED) (1987). Our Common Future: Brundtland Report.
Sustainable Natural Resource Management	Sustainable management of natural resources is defined in the Welsh Environment Act as: "using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, meeting the needs of present generations of people without compromising the ability of future generations to meet their needs, and contributing to the achievement of the well-being goals in the Well-being of Future Generations Act. The Act establishes the following principles for Sustainable management of natural resources:

<table>
<tr><th>Key concept</th><th>Selected definitions</th></tr>
<tr><td></td><td>
<table>
<tr><th colspan="3">Principles of sustainable management of natural resources</th></tr>
<tr><td></td><td>Adaptive management</td><td>manage adaptively by planning, monitoring, reviewing and where appropriate, changing action</td></tr>
<tr><td></td><td>Scale</td><td>consider the appropriate spatial scale for action</td></tr>
<tr><td></td><td>Collaboration and engagement</td><td>promote and engage in collaboration and cooperation</td></tr>
<tr><td></td><td>Public Participation</td><td>make appropriate arrangements for public participation in decision-making</td></tr>
<tr><td></td><td>Evidence</td><td>take account of all relevant evidence, and gather evidence in respect of uncertainties</td></tr>
<tr><td></td><td>Multiple benefits</td><td>take account of the benefits and intrinsic value of natural resources and ecosystems</td></tr>
<tr><td></td><td>Long term</td><td>take account of the short, medium and long term consequences of actions</td></tr>
<tr><td></td><td>Preventative action</td><td>take action to prevent significant damage to ecosystems</td></tr>
<tr><td></td><td>Building resilience</td><td>take account of the resilience of ecosystems, in particular the following aspects:
(I) diversity between and within ecosystems;
(II) the connections between and within ecosystems;
(III) the scale of ecosystems;
(IV) the condition of ecosystems (including their structure and functioning);
(V) the adaptability of ecosystems</td></tr>
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<tr><td>Threat</td><td>A physical event or process that contains the possibility of being damaging or causing harmful consequences or loss. A threat is less specific than a particular hazard or risk, but may be reclassified as a ‘risk’ if it shifts from presenting merely the possibility of loss to a more certain probability of harm or damage (See Risk.) (Western Cape Government, 2010, p. 6).</td></tr>
<tr><td>Unique agricultural land</td><td>“Unique agricultural land” means land that is or can be used for producing specific high value crops. It is not necessarily high potential but important to agriculture due to a specific combination of location, climate or soil properties that make it highly suited for a specific crop when managed with specific farming or conservation methods. This includes land of high local importance where it is useful and environmentally sound to encourage continued agricultural production, even if some or most of the land is of mediocre quality for agriculture and is not used for particularly high value crops (Western Cape Government, 2019, p. 77).</td></tr>
<tr><td>Urban edge and urban fringe</td><td>A line that is used as a border to distinguish between (1) an area/region that is regarded as part of a city or town, and (2) its surrounding natural or rural area. Its primary purpose is to ‘contain the urban’ and as such, (1) no urban development is permitted, and (2) no municipal services are to be provided outside/beyond the line. As in the case of a rural edge, the line may have coordinates and be statutory, meaning it has binding legal power, or be seen as a ‘fuzzy/soft line’, meaning its exact coordinates are not defined, and it is to be used in a planning and policy sense and not as a hard, impenetrable</td></tr>
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Key concept	Selected definitions
	physical line ((Department of Rural Development and Land Reform, 2019, p. 21). Urban fringe: "The spatial transition area located between the built-up area of a town/urban centre and its rural hinterland. This zone links a core of concentrated population and activities with a set of dispersed activities dependent on natural resources. It is an area characterized by both urban and rural development pressures (Western Cape Government, 2000, p. 3).
Vulnerability	The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. Comment: There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure (Office of Disaster Preparedness and Management, 2020).
Water engineering and hydraulic engineering	Water engineering is an important discipline that aims to provide clean water and water safety, and it can be applied to every stage of the water cycle. Water engineering can be divided into further sub-sets: structural water engineering, water treatment and sewage treatment. Structural water engineering involves building, repairing and maintaining structures that control water resources. In terms of water cycle management most important ones are reservoirs, dams, sewerage and pumping stations. All these are important aspects of natural occurrence of water. Water engineering is about how water interacts with all aspects of the built and natural environments. Water engineering is concerned with: 1. Water needs for different users – this includes drinking water, water for industry and agriculture and, importantly, water for the natural environment. 2. Flooding. 3. Groundwater – water that lies in underground aquifers and deep in the soil. 4. Coastal water behaviour – what happens when rivers meet the sea, and when the sea meets the land? 5. Water quality requirements. Water engineering looks at the way that natural systems such as rivers, estuaries and the coasts behave, as well as designing infrastructure to store and direct water. Source: https://www.engineering.unsw.edu.au/civil-engineering/water-engineering

Key concept	Selected definitions
	In terms of water cycle management re-use treatments are more important than static structures like dams. Water treatment is any process that is used to remove contaminants from water and to improve the quality of water. Hydraulic engineering as a sub-discipline of civil engineering is concerned with the flow and conveyance of fluids, principally water and sewage. One feature of these systems is the extensive use of gravity as the motive force to cause the movement of the fluids. This area of civil engineering is intimately related to the design of bridges, dams, channels, canals, and levees, and to both sanitary and environmental engineering. Hydraulic engineering is the application of the principles of fluid mechanics to problems dealing with the collection, storage, control, transport, regulation, measurement, and use of water (Prasuhn. 1987).
Water Management Area	An area established as a management unit in the national water resource strategy within which a catchment management agency will conduct the protection, use, development, conservation, management and control of water resources (National Water Act No. 36 of 1998)
(Integrated) Water Resource Management (WRM)	Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management. Much effort in water resource management is directed at optimizing the use of water and in minimizing the environmental impact of water use on the natural environment. The observation of water as an integral part of the ecosystem is based on integrated water resource management, where the quantity and quality of the ecosystem help to determine the nature of the natural resources. IWRM is a framework designed to improve the management of water resources based on four key principles adopted at the 1992 Dublin Conference on Water and the Rio de Janeiro Summit on Sustainable Development. These principles hold that: 1. Fresh water is a finite and vulnerable resource essential to sustain life, development, and the environment; 2. Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels; 3. Women play a central part in the provision, management, and safeguarding of water; and 4. Water has an economic value in all its competing uses and should be recognized as an economic good. (International Conference of Water and the Environment (ICWE) (1992), The Dublin Statement on Water and Sustainable Development, http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html)
Water scarce regions	This construct refers to (1) the 'climate capability' of a region, which is a function of the moisture supply, climate constraints and physiological capacity of a region, and (2) the impact of climatic factors on the capability to grow an agricultural crop in a region within a growth season. For the purposes of the NSDF, areas described as 'Water Scarce Regions' fall within the 'low to low-moderate' climate capability ranges (Department of Rural Development and Land Reform, 2019, p. 21).

Key concept	Selected definitions
Water-use efficiency	Water Use Efficiency (WUE) at national level is the sum of the efficiencies in the major economic sectors weighted according to the proportion of water withdrawn by each sector over the total withdrawals (Food and Agriculture Organization of the United Nations (FAO), 2020).

Annexure 4: Summary of the May 2019 Draft National Policy on Conservation Agriculture

The draft policy addresses a need to move away from conventional farming systems, towards CA. The following is envisaged for CA: "It is envisaged that CA will transform South African land use systems towards a sustainable food production system, adopted by the majority of farmers, which will increase the food security status of South Africa and its citizens, whilst reducing vulnerability to food scarcity and the related risk to national security" (Department of Agriculture, Forestry and Fisheries, 2019, p.10).

Hence the objective is: "To promote and establish ecologically and economically sustainable agricultural systems that will increase food security levels and address associated national security risks" (Department of Agriculture, Forestry and Fisheries, 2017, p. 9).

The draft policy lists the following outcomes which should be achieved through effective implementation of the policy and broader adoption of CA practices by the agricultural sector:

- An increase in soil organic matter.
- Reduced green-house gas emissions due to less external inputs and more carbon sequestration.
- Increased water infiltration that reduces runoff, soil erosion and sedimentation, and improves surface and groundwater levels and quality – land rehabilitation.
- Increased commodity and livestock production, performance and resilience.
- Compliance to environmental legislation.
- Improved biodiversity and ecosystem functioning.
- Lower production costs

The draft policy proposed the following options to encourage uptake of CA:

- Provide visible support, build capacity and allocate resources to initiatives adopting CA.
- Incentivise farmers using CA, provide tax rebates and introduce carbon tax.
- Invest in research on CA practices.
- Create awareness of the benefits of CA.
- Strengthen regulatory tools to minimise carbon loss and soil disturbance associated with land tilling.
- Include a gender focus in acknowledgement of the particular challenges women in agriculture face (Department of Agriculture, Forestry and Fisheries, 2017).

The draft policy makes recommendations for implementation. The recommendations most relevant to SRM include:

- Formalise CA institutional structures for implementation and include farmers as key implementing role-players.

- Capacity building and support services at all levels by disseminating documentation and publications of case studies, evidence-based learning, promoting practical and effective local solutions and learning materials.
- Incentivise and make funding available, this will include focusing on research; training; infrastructural development and relevant services, resources and incentive schemes
- Development of CA information management and monitoring system which can monitor CA practices at a farm level (Department of Agriculture, Forestry and Fisheries, 2017).

The policy states that "The State should provide producers with incentives to adopt CA practices by rewarding farmers for managing their land sustainably leading towards improved ecosystem services. There are current examples of such incentive schemes, such as payment for ecosystem services (PES) and carbon markets. This transparent system of conditional payments to voluntary providers of environmental services, to be administered by the state, through local farmer-centred innovation platforms, should also be designed and marketed extensively, in order to promote adoption…. The public sector can focus on research; training; infrastructural development and relevant services, resources and incentive schemes (subsidised equipment, tax rebates, etc.)…. The introduction of incentives for provision of no till planters to smallholders will propel a switch from conventional system to Conservation agriculture, while support on cover crops will ensure that all principles of CA are applied by farmers.

The policy states that DAFF will convene a national forum to take forward implementation of the plicy: "To implement the policy, its custodian, the DAFF will convene a relevant stakeholders' forum that includes key private and public sector partners. The forum will oversee the implementation of the policy as well as the monitoring and evaluation of the progress achieved over a given period of time." (DAFF. May 2019: 15).

Annexure 5: Conservation Agriculture Proposals made by AgriSA in its 2017 comment on South Africa's carbon tax

Farmers should be encouraged to take-up sustainable land management practices to sequester carbon as this is the thrust of overcoming inevitable emissions as discussed. This requires a well-designed approach based on scientific practices and research, a comprehensive legal framework, facilitative mechanisms to educate and promote land-use change and a range of financial and market- based economic incentives to kick-start and then reward actions that realise or have the potential to realise improvements.

Specific to conservation agriculture (CA):

Education and empowerment to mainstream CA and other sustainable, regenerative agricultural practices are pivotal and should receive priority. The following could be used as guidance in any such endeavour, both through private (e.g. commodity bodies) and government initiatives:

- Facilitate the formation and operation of farmer innovation platforms or -systems, for sharing, learning, implementation and scaling out of CA practices.
- Facilitate research where different stakeholders (i.e. scientists/researchers, extension officers, farmers, agri-business) share responsibilities. In this context, launch R&D projects for the development of robust monitoring and assessment frameworks (spatial and temporal) in support of the DEA's MRV system for GHG emissions, carbon footprint and sequestration under various land use systems (e.g. grain crops and horticultural activities). Pilot projects should also prioritise the collection of benchmark data for different industries and regions.
- Educate and involve extension officers to learn, participate in and facilitate innovation platforms and research.
- Improve the general awareness and understanding, through among others social media, publications, conferences and farmers' days, of the impact (carbon footprint) and the sustainability of the various farming systems.
- Identify and/or strengthen the various rural institutional arrangements, especially under smallholder farmers and communal systems, as platforms to improve local crop production systems through CA.
- Investigate, develop and introduce appropriate incentive and market-based mechanisms (such as PES) to facilitate CA on a broader scale across the country. Such mechanisms should be tailored for smallholder (from subsistence to semi- commercial) and commercial farmers. These mechanisms should also consider various carbon offset models with agricultural input supplier partners.

Specific to rangeland management:

Some of the above initiatives also apply here. Rangeland management is guided by grazing capacity and stocking rate relative to a defined standard, the Large Stock Unit (LSU). All districts have DAFF approved grazing capacities described in ha/ LSU. However, individual farms per district may differ in grazing capacity from the approved because of differences in local plant cover, species composition and rangeland condition.

To maximise carbon storage and sustainability, rangeland condition should be optimum with regard to plant cover, species composition and restoration of bare patches and eroded areas.

However, this has cost implications which should be supported by government by financial incentives (e.g. PES).

Government, through DAFF, should employ extension officers well trained in rangeland management in every district and retrain the many extension officers serving communal systems. Extension officers should evaluate grazing capacity on individual farms, communal systems and commonages to determine more precise stocking rates and monitor rangeland condition and species composition at regular intervals. They should also assist with restoration of bare patches and eroded areas by advice and administering funds made available for this purpose. Furthermore, the extension officers should be trained to determine carbon storage and sequestration in order to over time and at regular intervals monitor progress. In liaison with the extension services, large carbon offset investment programmes for companies will also become viable because districts, commonages and communal systems can be included in toot to the benefit of carbon storage and socio- economic support.