CLIMATE CHANGE ADAPTATION FOR SMALLHOLDER FARMERS IN SOUTH AFRICA

VOLUME 2 PART 1: COMMUNITY CLIMATE CHANGE ADAPTATION FACILITATION: A MANUAL FOR FACILITATION OF CLIMATE RESILIENT AGRICULTURE FOR SMALLHOLDER FARMERS

E Kruger

WATER RESEARCH COMMISSION

TT 841/2/20

Climate Change Adaptation for Smallholder Farmers in South Africa

Volume 2 Part 1: Community Climate Change Adaptation facilitation: A manual for facilitation of Climate Resilient Agriculture for smallholder farmers

Report to the

Water Research Commission

by

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Mahlathini Development Foundation

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Volume 1: Climate Change Adaptation for smallholder farmers in South Africa. An implementation and decision support guide. Summary report. (WRC Report No. TT 841/1/20)
Volume 2 Part 1: Community Climate Change Adaptation facilitation: A manual for facilitation of Climate Resilient Agriculture for smallholder farmers. (WRC Report No. TT 841/2/20)
Volume 2 Part 2: Climate Resilient Agriculture. An implementation and support guide: Intensive homestead food production practices. (WRC Report No. TT 841/3/20)
Volume 2 Part 3: Climate Resilient Agriculture. An implementation and support guide: Local, group-based access to water for household food production. (WRC Report No. TT 841/4/20)
Volume 2 Part 4: Climate Resilient Agriculture. An implementation and support guide: Field cropping and livestock integration practices. (WRC Report No. TT 841/5/20)
Volume 2 Part 5: Climate Resilient Agriculture learning materials for smallholder farmers in English. (WRC Report No. TT 841/6/20)
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ABBREVIATIONS AND ACRONYMS

AEZ	Agroecological zone
CA	Conservation agriculture
CC	Climate change
CCA	Climate change adaptation
CoP	Community of practice
CRA	Climate resilient agriculture
CSA	Climate smart agriculture
CSO	Civil society organisation
DEA	Department of Environmental Affairs
DSS	Decision support system
NGO	Non-government Organisation
OC	Organic carbon
PAR	Participatory Action research
PIA	Participatory impact assessment
PID	Participatory innovation development
PLA	Participatory learning and action
PRA	Participatory rural appraisal
PTD	Participatory technology development
RWH	Rainwater harvesting
SLT	Social learning theory
SWC	Soil and water conservation

CONTENTS

Community CCA Facilitation

1 PROJECT OVERVIEW

This facilitation manual is one of the outputs for a Water Research Commission research brief entitled "*Collaborative knowledge creation and mediation strategies for the dissemination of water and soil conservation practices and climate smart agriculture in smallholder farming systems*", undertaken between 2017 and 2020.

The research objectives were defined as:

1. To evaluate and identify best practice options for climate resilient agriculture (CRA) and Soil and Water Conservation (SWC) in smallholder farming systems, in two bioclimatic regions in South Africa
2. To amplify collaborative knowledge creation of CRA practices with smallholder farmers in South Africa
3. To test and adapt existing CRA decision support systems (DSS) for the South African smallholder context
4. To evaluate the impact of CRA interventions identified through the DSS by piloting interventions in smallholder farmer systems, considering water productivity, social acceptability and farm-scale resilience
5. To test visual and proxy indicators appropriate for a Payment for Ecosystems based model at community level for local assessment of progress and tested against field and laboratory analysis of soil physical and chemical properties, and water productivity.

The design of the decision support system is seen as an ongoing process divided into three distinct parts:

- **Practices:** Collation, review, testing and finalisation of those CRA practices to be included. This allows for new ideas and local practices to be included over time and also includes linkages and reference to external sources of technical information around climate change, soils, water management, etc. and how this will be done
- **Process:** Through which CRA practices are implemented at smallholder farmer level. This also includes the facilitation component, communities of practice, communication strategies and capacity building and
- **Monitoring and evaluation:** Design and implementation of local and visual assessment protocols for assessing implementation and impact of practices as well as processes used. This also includes site selection and quantitative measurements undertaken to support the visual assessment protocols and development of visual and proxy indicators for future use in incentive-based support schemes for smallholder farmers.

This manual focusses on the process; the methodological and facilitation components of the research brief.

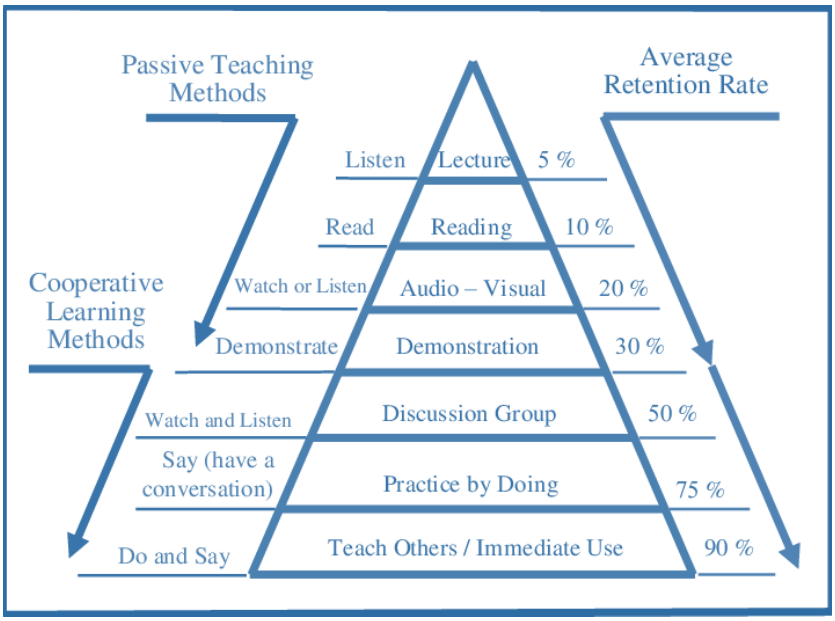
2 BRINGING TOGETHER THE METHODOLOGICAL ELEMENTS

When engaging with smallholder farmers the socio-cultural, economic and environmental complexities of these farming systems need to be taken into account; explored, understood and managed. Any new ideas and processes need to be facilitated inclusive of all socio-cultural, economic and environmental aspects and in a setting of open dialogue and learning.

2.1 LEARNING AND CHANGE

To engage in exploring the change in farming systems happening due to climate change and thinking into the kinds of changes required to consciously adapt to these changes, requires both the process of learning (including new ideas and information into the mix) and the process of doing (how to implement and farm differently).

As adults, we learn best by doing. We retain the least information when we just listen to talks and presentations or read. The diagram below provides a visual representation of how we best remember. It also shows that combining learning and implementation and working in groups are generally the most effective ways to learn.



Learning Pyramid (Adapted from National Training Laboratories Bethel, Maine, USA) (Dale E, 1969)

Figure 1: The learning pyramid demonstrating retention of information in different learning scenarios

It is widely appreciated that information on its own does not lead to capability development and that education, training, knowledge dissemination and communication involving a range of knowledge dissemination and mediation processes are required for information to translate into action (Lotz-Sisitka and Pesanayi, 2019).

There are a number of different ways in which to understand learning and behaviour change in adult learning processes. These processes have been defined within the ambit of educational psychology, but are a useful tool in designing earning programmes for behaviour change.

Over the years, academics have proposed a number of theories to describe and explain the learning process – these can be grouped into five broad categories:

1. Behaviourist
2. Cognitivist
3. Constructivist
4. Experiential
5. Social and contextual

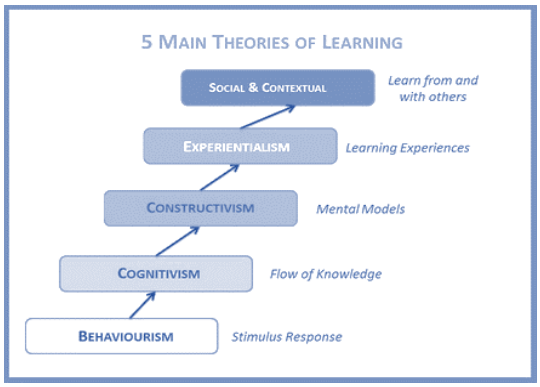


Figure 2: Five main learning theories

Behaviourism: Key behaviourist thinkers hypothesized that learning is a change in observable behaviour caused by external stimuli in the environment (stimulus-response). The key principle of behaviourism is the reward or punishment of a new behaviour, commonly described as the 'carrot and stick' approach to learning.

Cognitivism: Cognitivism replaced behaviourism as the dominant learning paradigm in the 1960s and proposes that learning comes from mental activity such as memory, motivation, thinking and reflection. Cognitivism focuses on the transmission of information from someone who knows (such as an 'expert' as opposed to facilitators) to learners who do not know.

Constructivism: From the constructivist perspective, learning is not a stimulus-response phenomenon as described by behaviourism, rather it requires self-regulation and the building of conceptual structures through reflection and abstraction. The learner takes an active role in constructing her own understanding rather than receiving it from someone who knows, learning through observation, processing and interpretation.

Experientialism: One of the key theorists of experiential learning is David Kolb who developed his experiential model, as opposed to a purer cognitive model which formally recognised that people learn from experience and described learning as following a cycle of experiential stages (observation, action and reflection).

Social and Contextual: In this approach, learning does not occur solely within the learner, but in the group (or context) and community in which they work. Learning is a shared process which takes place through observing, working together and being part of a larger group, which includes colleagues of varying levels of experience, able to stimulate each other's development. (Thompson, 2012)

Social learning is the most appropriate learning approach for working in complex community-based situations.

2.2 SOCIAL LEARNING, KNOWLEDGE MEDIATION

Social Learning Theory is a theory of the learning process which combines elements of behavioural, cognitive and constructivist approaches. Learning is not purely behavioural, but is a cognitive process that takes place in a social context.

Key tenets of Social Learning Theory (SLT) are as follows:

- Learning can occur by observing a behaviour *and* by observing the consequences of the behaviour
- Learning involves observation, extraction of information from those observations, and making decisions about the performance of the behaviour (observational learning or modelling). Thus, learning can occur without an observable change in behaviour.
- Reinforcement plays a role in learning but is not entirely responsible for learning and

- The learner is not a passive recipient of information. Cognition, environment, and behaviour all mutually influence each other.

According to the **sociocultural theory** of education (an extension of SLT), learning is social; we learn through interacting with others, through a meaningful exchange of ideas, concepts, and actions. **Knowledge is mediated** through dialoguing with the other (other members of the community, stakeholders, facilitators, etc.). This process allows for the negotiation of meaning through dialogues with others who have a different understanding of the topic. It allows for the interplay between different sociocultural perspectives and the development of new understanding that can lead to different actions and behaviours, or stated in a slightly different way"

"Contemporary theories of learning and change indicate that for knowledge or information to become meaningful, there is 1) a need for the information to be related to the situation and experience of the user; and that this needs to 2) be mediated in context; in addition to 3) providing new knowledge or information that can expand existing knowledge and/or practice" (Lotz-Sisitka and Pesanayi, 2019).

The model proposed by Shaxson et al. (2012), which proposes a 'continuum' of knowledge dissemination approaches, contexts and relations within a systems approach to learning provides a useful framework for project or programme design that incorporates social learning and change and has recently been used in the Amanzi for Food social learning network approach (Lotz-Sisitka and Pesanayi, 2019).

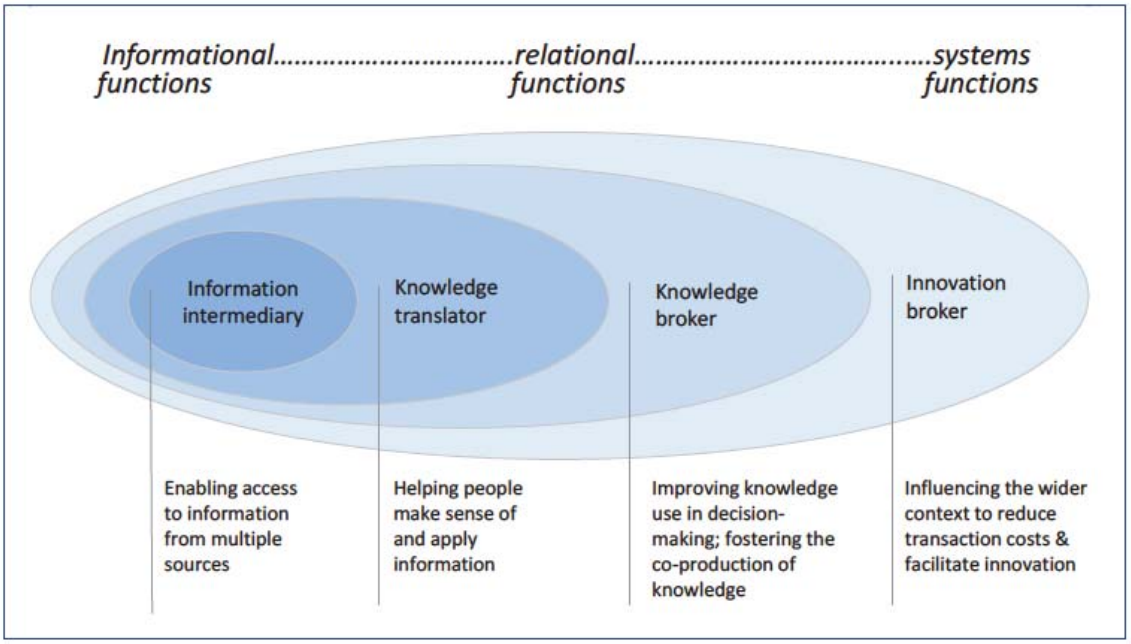


Figure 3: Knowledge dissemination continuum from Shaxson et al., 2012

Here, this framework will be used as a basis for building the methodological approach for innovation system development and decision support for implementation of CRA in smallholder farming systems

2.3 AGENCY

The concept of agency, developed in the Social Sciences can be considered as an aspect of learning within this sociocultural context. This concept helps us to more clearly understand the interplay between learning and doing.

A**gency** is the capacity of individuals to act independently and to make their own free choices and decisions. Social structure is a combination of factors (such as social class, religion, gender, ethnicity, ability, customs, etc.) that determine, or limit an **agent** and their decisions.

The ways in which people understand their own relationship to the past, future, and present also make a difference to their actions; there are cultural habits and ways of understanding one's place in the world, that sustain identities, meaning and interactions over time. These differ between cultures and change over time. It is also possible for individuals within cultures to change their own understanding of their role and their understanding of the world as more or less responsive to human imagination, purpose, and effort. While repertoires are limited by individual and collective histories and may be more or less extensive and flexible, they do require a certain degree of manoeuvrability in order to assure the appropriateness of the response to the situation at hand.

Habitual actions are largely unreflective (not thought about) and taken for granted, but are nevertheless a form of agency, as they involve attention and effort. People encounter problematic situations that need imagination and judgement solve and these situations provide for reflection and the analysis of patterns that may in some contexts allow for greater imagination, choice, and conscious purpose. (Emirbayer and Mische, 1998)

But people do not merely repeat past routines, they are also the inventors of new possibilities for thought and action. A certain increase in freedom and flexibility of action is possible, as one becomes more conscious of one's situation. "Experience in its vital form is experimental, an effort to change the given; it is characterized by projection, by reaching forward into the unknown." (Dewey, 1981)

We draw upon past experiences (our own and that of others) in order to clarify motives, goals, and intentions, to locate possible future constraints, and to identify morally and practically appropriate courses of action.

After surveying possible scenarios of action, actors face the task of proposing solutions that will adequately respond to their moral, practical and emotional concerns. Such resolutions will often attempt to resolve several conflicts simultaneously and to incorporate different fields of intended action. They may be put to the test in tentative or exploratory social interactions; interactions that may be transformative in nature. (Hays, 1994)

Even relatively unreflective routine dispositions must be adjusted in changing situations; and newly imagined projects must be brought down to earth within real-world circumstances. Moreover, judgments and choices must often be made in the face of considerable ambiguity, uncertainty, and conflict; means and ends sometimes contradict each other, and unintended consequences require changes in strategy and direction.

By increasing their capacity for practical evaluation, actors strengthen their ability to exercise agency in a mediating fashion, enabling them (at least potentially) to pursue their projects in ways that may challenge and transform their societies. (New, 2007)

This orientation toward action provides a powerful tool to respond to a rapidly changing world; composed of increasingly complex and overlapping matrices of social, political, and economic relations. If we cannot control the consequences of our interventions, we can at least commit ourselves to a responsive, experimental, and deliberative attitude as we confront emergent problems and possibilities across the variety of contexts within which we act.

2.4 SOCIAL ENGAGEMENT

From the previous sections, we have ascertained that involvement in any communities, including rural, farming communities, is a process of social engagement first and foremost as well as a process of research; exploration, understanding and trying out new ideas.

Key principles of engagement resonate with the previously discussed concepts of learning processes and agency and can be summarised as follows:

COLLABORATION: Researchers and community members co-create the intervention; Assessment of need, design of intervention, and evaluation are done together, with community inputs

carrying weight. Collective self-determination should be the basis for needs assessment. This requires flexibility as the intervention may take new directions not initially envisioned by researchers.

***INCLUSION: Everyone who has a stake in the intervention has a right to participate in processes and decisions*;** Efforts are made to ensure no one who has stake is excluded from participation or decision making on the basis of any demographic or socio-political factor. Work for diversity. The research team will not default to working with visible or influential players. The vulnerable, marginalised, least vocal will be actively included. Be aware of how power is recognised, structured and shared in a community.

***SAFETY: The process and intervention are conducted in a way that is safe for all participants*;** This includes the spaces chosen for meetings, the design of processes and interactions (e.g. how small groups are set up), the design of learning tasks (begin with simple, clear tasks). Allow small groups to find their voices. Establishing competence and experience contributes to safety. Make space for informal interactions where views or needs can be expressed in safety.

***RESPECT AND BUILD ON LOCAL AND TRADITIONAL KNOWLEDGE*:** People are experts in their own context and what they know is the foundational for new engagement. The research team must become thoroughly acquainted with the community: culture, social networks, economic conditions, demographics, history with other interventions – and respond to the realities and dynamics that exist.

***MUTUALITY AND EQUALITY IN LEARNING: Everyone already has knowledge and experience, everyone will learn*;** Prior knowledge of everyone is taken into account; life experience is used as the basis for relating to new knowledge, attitudes or skills. Researchers and participants are equals; all are learners. Peers challenge and mentor each other. Aim for both individual and collective learning and growth.

PRAXIS: Learning is structured through active doing and reflecting; Learners consider new content (skills, knowledge, attitudes) and re-create them to fit their context, then try it and reflect on how it works. Learning happens with the mind, emotions and muscles. Passive learning teaches passivity. The process, not only the outcomes, are important.

BUILD A CULTURE OF OPEN DIALOGUE: Encourage expression of different opinions and value minority views and individual insights. Talk transparently about power dynamics.

FLEXIBILITY: The research, programmes, projects and interventions must serve the wellbeing of the community and the environment; not the other way around. They should be structured with reflective processes that allow them to be reshaped as needed as a clearer perspective unfolds.

TRANSPARENCY AND ACCOUNTABILITY; Work for a culture where researchers and community members operate with transparency and are accountable for their roles and actions. Work for a culture of accountability to oneself for realising one's aims in the process.

***BUILD FOR THE LONG TERM*;** Build into the intervention mechanisms to sustain collaborations over the long term and work to mobilise community assets to this end; as collaborations mature and grow, their ability to address complex and long-range issues also grows.

2.5 COMMUNITIES OF PRACTICE

Communities of Practice (CoPs) are a progressive theory of knowledge management, knowledge creation and learning; knowledge mediation. It is a type of contextualised learning, proposing that the learning process of an individual is much more than the cognitive process of acquisition of skills and knowledge but situated in a social context, and it is through participation in the social context that the learning process occurs. (Lave and Wenger, 1991)

It thus depends on a group of people, contextually defined, who share a common interest and a desire to learn from and contribute to the community with their variety of experiences. Stated more simply, the primary purpose of a CoP is to provide a way for practitioners to share tips and best practices, ask questions of their colleagues, and provide support for each other.

Work on large, complex projects goes beyond the knowledge of one person to require the knowledge and skills of people from different disciplines. They need to coordinate their activities and synthesize their knowledge. Cross-disciplinary team participation requires an ability to negotiate team process and participate in decision-making (Poggenpohl, 2015). It moves from primary experience through refined reflection to explanation; moving from the tacit to the explicit.

For example, both research and practice can develop theory, theory needs to be proven through practice, practice can flag needs for research, research can overthrow theory, and research can improve the performance of practice. Research, theory, and practice are not isolated activities, but are tightly interrelated.

Figure 4: The relationships and interplay between research, theory and practice

Communities of practice are important because they:

- Connect people who might not otherwise have the opportunity to interact; either as frequently or at all,
- Provide a shared context for people to communicate and share information, stories, and personal experiences in a way that builds understanding and insight,
- Enable dialogue between people who come together to explore new possibilities, solve challenging problems, and create new, mutually beneficial opportunities,
- Stimulate learning by serving as a vehicle for authentic communication, mentoring, coaching, and self-reflection,
- Capture and diffuse existing knowledge to help people improve their practice by providing a forum to identify solutions to common problems and a process to collect and evaluate best practices,
- Introduce collaborative processes to groups and organizations as well as between organizations to encourage the free flow of ideas and exchange of information,
- Help people organize around purposeful actions that deliver tangible results and
- Generate new knowledge to help people transform their practice to accommodate changes in needs and technologies.

Essential elements of a CoP:

- Share experiences and know-how
- Discuss common issues and interests
- Collaborate in solving problems
- Analyse causes and contributing factors
- Experiment with new ideas and novel approaches
- Capture/codify new know-how
- Evaluate actions and effects
- Learning

To design or set up a CoP the following steps to develop a well-defined purpose linked to the needs and potential benefits to members, are required:

1. *Developing relationships*: Interaction with and developing of a wider network of peers working with a process of building trust, reciprocity, mutual respect and commitment.
2. *Developing practice:* Practice evolves with the community as a collective product, becomes integrated into members' work and organizes knowledge in a way that reflects practitioners' perspectives. Successful practice development depends on a balance between "the production of 'things' like documents or tools and deep learning experiences for community members.
3. *Carrying out tasks and projects:* Small group projects, sponsored by the community, help members create personal relationships and also provide a way to produce the resources for developing the practice: cases, effective practices, tools, methods, articles, lessons learned, databases, learning tools and aids, models and the like.
4. *Creating new knowledge:* Members go beyond current practice to explore the cutting edge of the domain, to innovate. Community may redefine its boundaries and membership and foster boundary-crossing, possibly working with people from other communities to explore emerging technologies, practices, and ideas.

Actions for the CoP are based on the premises of inquiry, design, activities, communication, interaction, learning, knowledge sharing, collaboration, roles and social structures and piloting and roll out of the processes.

Examples of CoPs are learning groups, innovation platforms, forums, networks and research and implementation teams.

2.6 INNOVATION SYSTEMS

Methodologies for agricultural development and research have been designed to incorporate the concepts of social engagement, learning, experimentation and agency into the process.

The international development community is giving increased attention to agricultural innovation processes and systems that lead to outcomes at scale. Inclusive multi-dimensional and multi-stakeholder learning processes are seen as important. Smallholder family farmers become more central in the design and implementation of research processes as partners in planning and implementation processes (Kruger and Gilles, 2014).

Key trends in Participatory Agricultural development thinking show a movement or change from:

- Increases in production to improvement in local livelihoods,
- Technology transfer to local innovation development,
- Beneficiaries of projects to influential stakeholders within programmes,
- Technology transfer to co-development of innovation systems,
- Functional participation to empowerment and
- Applied and adaptive research to strategic and pre-adaptive research.

Global experience shows that new ways of thinking about and doing agricultural research and development are required. The basic paradigm shift is one of moving away from the idea that research and development is a process of generating and transferring modern technology to farmers. And then moving towards seeing the idea as an inclusive multi-dimensional learning process that:

- Works from a holistic perspective that includes biophysical, socio-political and economic perspectives in agriculture and natural resource management,
- Draws upon diverse sources of knowledge – from local to global,
- Provides for meaningful participation of user groups in the process of investigating improvements in local situations,

- And builds synergy between local capacities, resources and innovations by
    - Providing decision support tools and information that enables various types of users to make strategic choices and actions,
- Which results in a wide range of knowledge products (technological through to socio-political) for generating, sharing, exchanging and utilizing knowledge.

Now, concepts such as strategic and pre-adaptive participatory research become important as does the idea of best practise scenarios and options and the mainstreaming of cross cutting issues and themes. In many ways, these concepts are still in a developmental phase and are not as yet integral in existing institutional and research cultures.

The development of methodological frameworks and processes to encompass the above themes and goals has followed two broad tracks/lines depending to an extent, on the type of institution at work and their overall aims; namely Participatory Action research (PAR) and Participatory Innovation Development (PID). (Brock and Pettit, 2007).

2.7 PARTICIPATORY INNOVATION DEVELOPMENT (PID)

Participatory Innovation Development (PID) is an approach to learning and innovation that is used in international development as part of projects and programmes relating to sustainable agriculture. The approach involves collaboration between researchers and farmers in the analysis of agricultural problems and testing of alternative farming practices.

It has developed out of methodologies such as Farming Systems Research and Extension, PRA (participatory rural appraisal), PLA (participatory learning and action) and Indigenous Technical Knowledge Systems and incorporates further methodologies such as Farmer Field Schools.

This approach enables the research and development community to respond to locally defined problems and to find solutions that build upon local knowledge and are consistent with local resources and contexts. Moreover, by involving farmers as the users of the research process, it is more likely that farmers would share and use (new) knowledge.

Local innovation in agriculture and natural resource management goes beyond technologies to socio-organizational arrangements such as new ways of regulating the use of resources, new ways of community organization, or new ways of stakeholder interaction. The term Participatory Innovation Development (PID) embraces this broader understanding of joint research and development and is now being used alongside, or in place of PTD (Participatory Technology Development). It is a process in which farmers and other stakeholders engage in joint exploration and experimentation leading to new technologies or socio-institutional arrangements for more sustainable livelihoods. This action-oriented approach promotes engagement in a process that strengthens the capacities of agricultural services to support community-led initiatives (Hartmann, 2009, Wettasinha et al., 2009).

The following statement in a recent publication in the agricultural development and extension field, sums up the imperative for working with these approaches:

"Scientists are being challenged to re-consider that their role in technology development is through innovation and a complex process involving a reorganization of social relationships, not just technical practice. In this context, technology shifts from something to be applied to something leveraged for networking and organizing. To ensure the future, the idea of sustainability as a dynamic process rather than an endpoint offers a route for understanding and engagement between research, policy and personal spheres. For both research and extension agendas; in considering traditional agriculture in the context of economic development we have to create the capacity to co-operate in a way that opens up the possibility of social change; a way of interacting that preserves and creates new forms of social cohesion. Researchers will come to understand that attitude, environment and relevant issues, not specific tools, achieves participation" (Caister et al., 2012).

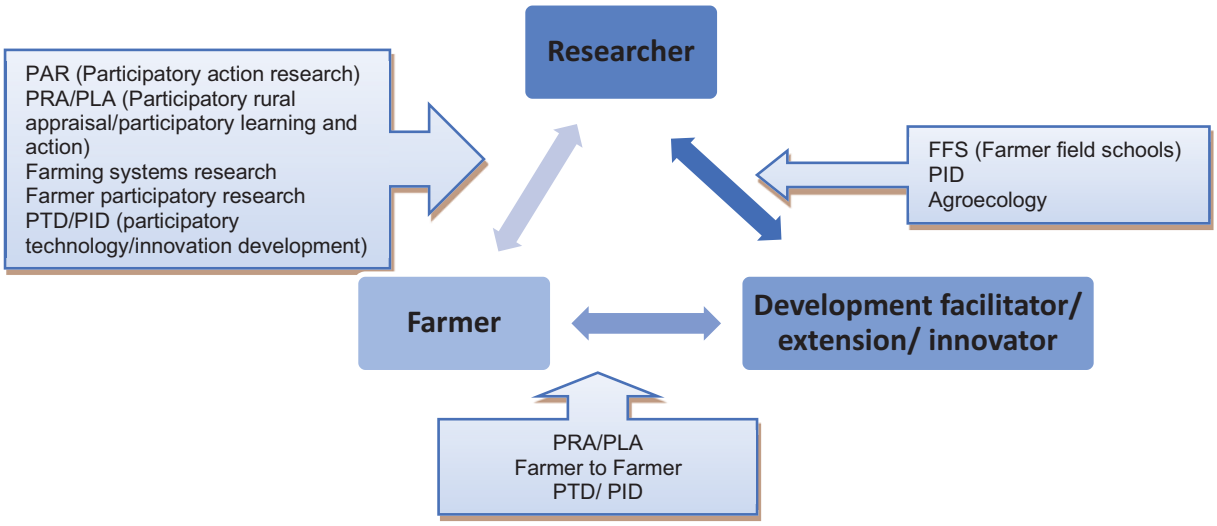


Figure 5: The interplay between researchers, facilitators and farmers, indicating associated methodologies

Farmer led innovation builds on the PID concepts to include local innovations into the system and describes the interaction between local communities and outside facilitators, as:

- Gaining a joint understanding of the main characteristics and changes of that particular agroecological system,
- Defining priority problems,
- Experimenting locally with a variety of options derived both from indigenous knowledge … and from formal science and
- Enhancing farmer's experimental capacities and farmer-to-farmer communication (Wettasinha et al., 2009, Rai and Shrestha, 2006).

The text box alongside provides an example of steps that can be followed to implement a farmer led innovation process.

A summary of the Farmer Led Innovation steps

1. Getting started (getting to know each other);
2. Joint analysis of the situation – the problems and opportunities;
3. Looking for things to try to improve the local situation;
4. Trying them out in community-led participatory experimentation;
5. Jointly analysis and sharing the results; and
6. Strengthening the process, often through improving local organization and linkages with other actors in R&D, so that the innovation process will continue.

2.8 ADDING THE ELEMENTS TOGETHER: COACTIVE GOVERNANCE IN A CHANGING CLIMATE

The concept of coactive governance is borrowed from industry, where it is being developed to manage service relationships. This new way shares strategy and responsibility between the client and provider equally and allows an innovation environment to flourish. Implementing collaborative models in enterprise environments requires organizational readiness – that is, willingness – to adopt a different working attitude that accepts change as a condition, rather than an event (Batty, 2017).

In this process we need to combine and synergise the way people learn, what they learn and how they incorporate this learning into changing their practice into a coherent model that can support an individual farmer's decision-making process about which adaptive practices to implement in their context and farming system.

3 CLIMATE CHANGE

There is ample evidence of national and local changes in the temperature and rainfall climatology of South Africa over at least the past five decades and a high probability that these changes will increase in the coming decades:

- Mean annual temperatures have increased by more than 1.5 times the observed global average of 0.65°C,
- Maximum and minimum temperatures have been increasing annually and in almost all seasons,
- Hot and cold extremes have increased and decreased respectively in frequency, in most seasons across the country, particularly in the western and northern interior,
- In almost all hydrological zones there has been a marginal reduction in rainfall for the autumn months. Annual rainfall has not changed significantly, but an overall reduction in the number of rain days implies a tendency towards an increase in the intensity of rainfall events and increased dry spell duration and
- Extreme rainfall events show a tendency towards increasing in frequency annually, and especially in spring and summer, with a reduction in extremes in autumn (DEA, 2013).

Given South Africa's present trajectory and already alarming increase in average temperatures, the predictions of strongly increased drought, increased rainfall variability and strongly increased extreme rainfall events into the future are all but guaranteed.

Climate change impacts on South Africa are likely to be felt primarily via effects on water resources; with increased evapotranspiration, run-off and soil erosion and reduced surface and underground water reserves. Significant trade-offs are likely to occur between developmental aspirations, particularly in terms of the allocation between agricultural and urban-industrial water use, linked to the high costs of enhancing water supply (DEA, 2017).

With regard to the impact of climate change on food security in Southern Africa, the IPPC makes the following predictions:

- Maize-based systems, particularly in Southern Africa, are among the most vulnerable to climate change with predicted yield losses for South Africa and Zimbabwe in excess of 30%,
- Loss of livestock under prolonged drought conditions is a critical risk given the extensive rangeland in Southern Africa that is prone to drought,
- Groundwater recharge may also be significantly affected by climate change in areas that receive less than 500 mm per year.

3.1 CLIMATE CHANGE ADAPTATION

Small-holder farmers and pastoralists in particular are being especially hard hit by these changes. Many of these small-scale producers are already coping with a degraded natural resource base. They often lack knowledge about potential options for adapting their production systems and have limited assets and risk-taking capacity to access and use technologies and financial services (SARVA, 2013).

Climate change is intricately linked to almost all facets of our society, particularly socio-economic progression as resources such as water, feedstock in the form of food and fibre and biodiversity, amongst others determine the production potential of many sectors of the economy, which in turn affect human development aspirations of the country.

In South Africa, emphasis is being placed on the development of policies and strategies for climate change mitigation, albeit slowly, with a much smaller focus on adaptation. Nonetheless, processes such as collaborative, participatory research that includes scientists and farmers, strengthening of communication systems for anticipating and responding to climate risks, and increased flexibility in livelihood options, which serve to strengthen coping strategies in agriculture for near-term risks from

climate variability, provide potential pathways for strengthening adaptive capacities for climate change (IPCC, 2014).

The IPCC defines adaptation as the “adjustments in human and natural systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities” (ibid.).

Planned adaptations to climate risks are “most likely to be implemented when they are developed as components of (or as modifications to) existing resource management programs or as part of national or regional strategies for sustainable development.” (ibid.).

3.2 CLIMATE SMART / RESILIENT AGRICULTURE

The United Nations Food and Agriculture Organisation (FAO) presented its response to climate change; an approach it has termed Climate Smart Agriculture (CSA) in 2010 (FAO, 2013). In this study, the research team opted to use the term Climate Resilient Agriculture (CRA), to clearly situate the practices promoted here within the agroecological sphere, rather than the technological and internet of things spheres, which are also considered climate smart under the broader definition.

According to the FAO, “Enhancing food security while contributing to mitigation of climate change and preserving the natural resource base and vital ecosystem services requires the transition to agricultural production systems that are more productive, use inputs more efficiently, have less variability and greater stability in their outputs, and are more resilient to risks, shocks and long-term climate variability. More productive and more resilient agriculture requires a major shift in the way land, water, soil nutrients and genetic resources are managed to ensure that these resources are used more efficiently” (ibid.)

CRA contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars:

1. Sustainably increasing agricultural productivity and incomes,

2. Adapting and building resilience to climate change and

3. Reducing and/or removing greenhouse gases emissions, where possible.

This approach aims to strengthen livelihoods and food security, by improving the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods. The approach is entirely compatible with the idea that CRA practices are essentially good developmental agricultural practices, applicable in and suitable for a wide range of contexts (ibid).

Climate Smart Agriculture is the overarching approach (shown in the diagram below) that has been used to inform this decision support process for smallholder farmers. All CSA practices have the potential to directly benefit farmers and increase food production in the communities as a whole, irrespective of any climate change predictions. However, they also have the capacity to buffer farmers against any increases in temperature or changes in rainfall quantities and patterns occasioned by climate change.

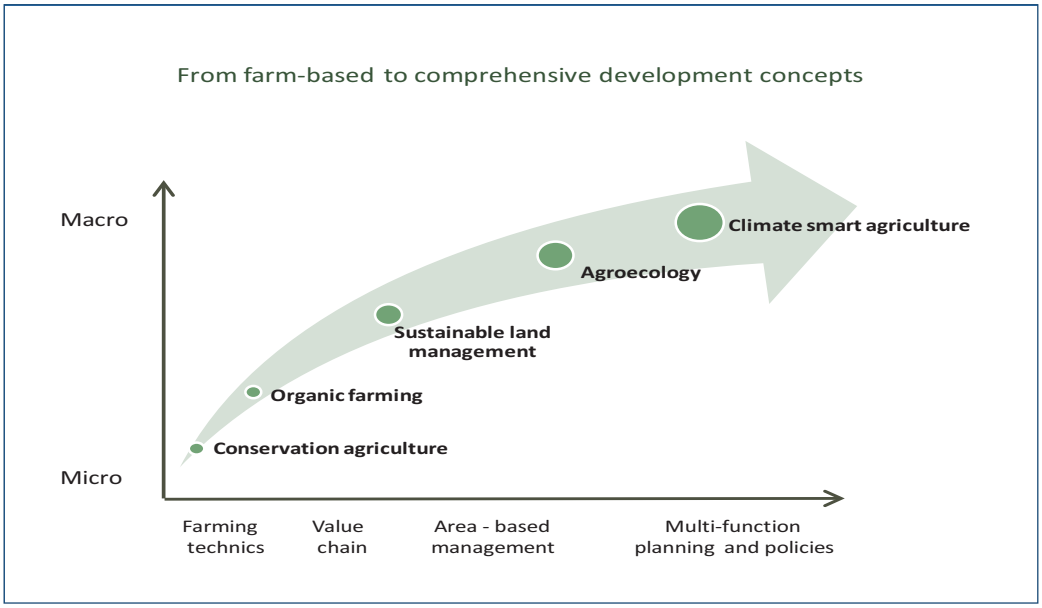


Figure 6: The FAO concept of CSA as an overarching approach to sustainable development (Arslan, 2014)

The FAO characterises CSA as an approach that:

1. Addresses the complex interrelated challenges of food security, development and climate change and identifies integrated options that create synergies and benefits and reduce trade-offs
2. Recognizes that these options will be shaped by specific country contexts and capacities and by the particular social, economic and environmental situation where it will be applied
3. Assesses the interactions between sectors and the needs of different involved stakeholders
4. Identifies barriers to adoption, especially among farmers and provides appropriate solutions in terms of policies, strategies, actions and incentives,
5. Seeks to create enabling environments through a greater alignment of policies, financial investments and institutional arrangements
6. Strives to achieve multiple objectives with the understanding that priorities need to be set and collective decisions made on different benefits and trade-offs
7. Prioritizes the strengthening of livelihoods, especially those of smallholders, by improving access to services, knowledge, resources (including genetic resources), financial products and markets
8. Addresses adaptation and builds resilience to shocks, especially those related to climate change, as the magnitude of the impacts of climate change has major implications for agricultural and rural development
9. Considers climate change mitigation as a potential secondary co-benefit, especially in low-income, agricultural-based populations and
10. Seeks to identify opportunities to access climate-related financing and integrate it with traditional sources of agricultural investment finance (FAO, 2013).

The FAO's description of CSA makes it clear that appropriate technologies that have been developed under different agricultural regimes can be entirely compatible with the broad concept of CRA. The approach here is to work directly with smallholders in local contexts to improve practices and synergise across sectors. The emphasis is thus at farm/household level. Here CRA aims to improve aspects of crop production, livestock and pasture management, natural resource management, as well as soil and water management as depicted in Figure 7.

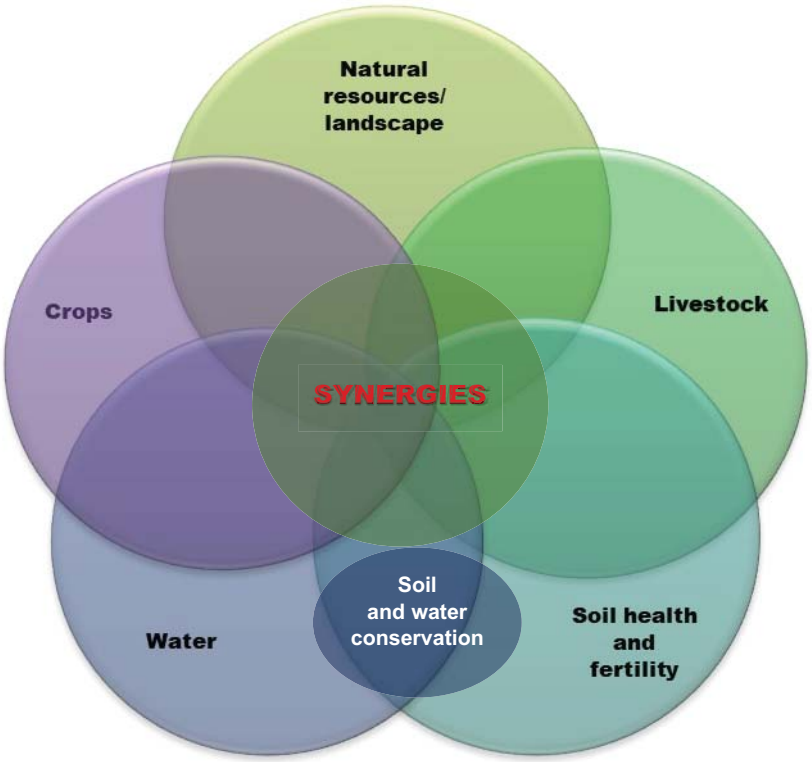


Figure 7: Household level implementation of CRA integrates across sectors (adapted from Arslan, 2014)

3.3 CONCEPTS OF VULNERABILITY AND RESILIENCE

Vulnerability is a function of two factors:

- Firstly, impact (exposure and sensitivity of exposure to climate change in turn)
  - Exposure – refers to the extent to which a system is impacted by climate change
  - Sensitivity – refers to how affected the system is after the exposure
- Secondly, adaptive capacity – the ability of the system to avoid potential damages, take advantage of opportunities and cope with the consequences of damages. It can also be framed as the capacity of people in a given system to influence resilience

Resilience is the ability of a system to anticipate, absorb, accommodate or recover from the effects of an extreme climate event in a timely and efficient manner.

Contextual vulnerability is locally focussed and considers the present as the departure point and considers socio-economic dimensions of vulnerability as a basis for assessing future vulnerability. This is largely a participatory process as opposed to modelling approaches that are applied at programme and policy scales. Vulnerability and adaptation needs are contextualised with the local context and will include factors that aren't necessarily directly linked to climate change or CRA.

Vulnerability and resilience frameworks are different in key aspects (FAO, 2013).

The vulnerability approach tends to:

- Be oriented towards research on hazards and risks
- Be centred on people and more translatable to application and policy outcomes
- Conduct assessments for single spatial scale and 'snapshots' in time
- Be less focused on ecological and environmental aspects and
- Assess present and future vulnerability from past information.

The resilience approach, on the other hand tends to:

- Be oriented towards ecological sciences
- Be more focused on complex interactions, feedbacks and processes of social-ecological systems
- Be conceptual and not easily translatable into practice
- Assess one particular system and can often not be generalised for wider application
- Produce more dynamic assessments (but with present methodological difficulties in measuring and characterising)
- Be less focused on the social aspects of social-ecological systems and
- Assess more positively future needs by building on present assets.

However, more recently, resilience frameworks are placing more emphasis on social systems (moving towards a social-ecological-system framework), while vulnerability frameworks are including more environmental factors and are thus becoming more alike. Nevertheless, both frameworks are connected through adaptive capacity assessments (FAO, 2013). Ultimately, the effect of any CRA intervention should contribute simultaneously to reduced vulnerability and increased resilience.

3.3.1 Vulnerability assessments

Vulnerability of livelihoods is determined by the capacity of communities to replace a negatively affected production system with one which would prevent losses in income, sustain subsistence production or supply food to markets. Vulnerability assessments characterise areas that have low livelihood resilience, allow for the identification of vulnerable subsectors in the community (e.g. elderly, women, youth) and provide the basis for developing strategies to increase the resilience of livelihoods to climate change (FAO, 2013).

A useful toolkit has been developed by the CGIAR/CCAFS (Ulrichs, Cannon, Newsham, Naess and Marshall, 2015). This vulnerability assessment toolkit for assessing community level potential for adaptation to climate change, can be used to understand the interrelations between climate impacts, food systems and livelihood strategies at the local level. It applies a multidimensional view of vulnerability of livelihood strategies to climate change, with a focus on differentiated access and entitlements to livelihood resources and food for different groups within the community (often determined according to gender, ethnicity and socio-economic class). It is based on a concept of five (5) Dimensions of Vulnerability (DoV), illustrated in Figure 8.

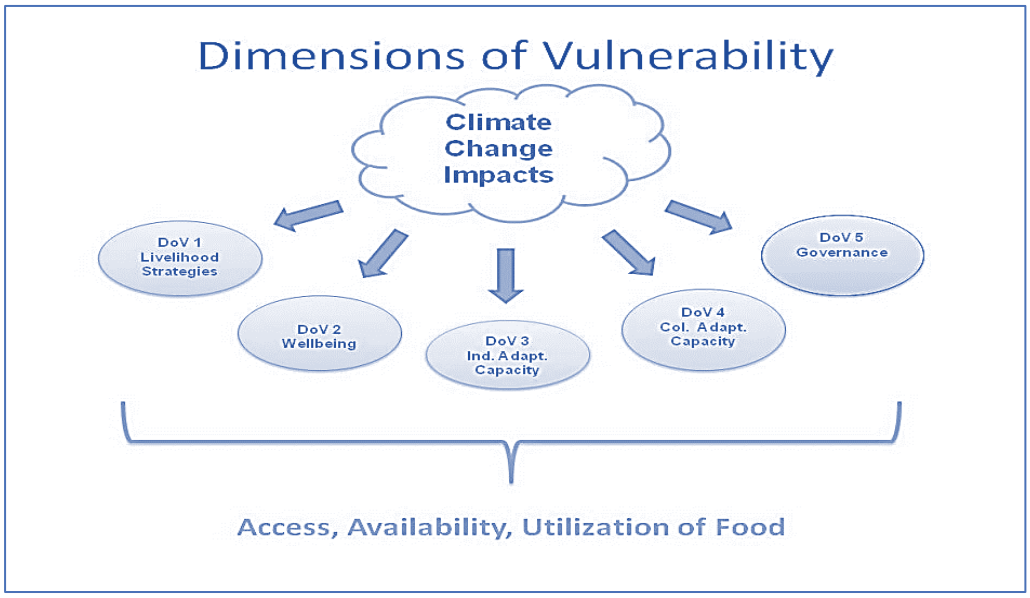


Figure 8: The 5 dimensions of vulnerability (CGIAR/CCAFS, 2015)

For each of these vulnerability dimensions a set of criteria and indicators can be developed to benchmark the baseline conditions in a locality. A wide range of participatory approaches, techniques and practices are available and include for example: transect walks, village mapping, historical timelines and climate trends, well-being ranking, seasonal calendars, ranking of livelihood strategies, chaining farming practices and crops, climate risk and coping mechanisms matrix, food system analysis and institutional mapping and Venn diagrams

3.4 SMALLHOLDER FARMING IN SOUTH AFRICA AND CRA

Development in South Africa is inextricably tied to massive challenges rooted in both the past and in the future. In the past, colonial appropriation and control of access to resources was taken to disastrous extremes through the policies of apartheid; twenty-five years into democracy poverty and dispossession still plague us. At the same time, problems anticipated in the future already loom large: South Africa as a water stressed country can expect to face particularly difficult challenges in terms of food security due to the increased temperatures and pests and decreased water access anticipated to result from climate change

About 2.5 million households (15,6%) were involved in agricultural activities in South Africa in 2017. Most of these households are found in Limpopo (25%), Eastern Cape (20%) and KwaZulu-Natal (20%). They are mainly headed by females (52,8%) and mostly involved in the production of fruits and vegetables (53,4%), grain and other food crops (51,8%), as well as in livestock (47,1%) and poultry (35,3%) farming. The main source of income for these households is social grants. Furthermore, most households involved in agricultural activities do so to supplement food for the household (43,7%) (StatsSA, 2017).

Poverty levels in the rural areas of South Africa are difficult to assess and are now believed to be a lot higher than the officially recorded level. Indigency, as recorded by the municipalities is around 22% of households, meaning that these households earn less than R3200/ month (7 household members). In 2015, over half of South Africa's population (55.5%) lived in poverty, below the poverty line – for which the upper bound poverty line was R1 183 per person in 2018. This percentage is slowly increasing every year. Poverty is highest in the provinces with the largest rural populations; the Eastern Cape, Limpopo and KwaZulu-Natal (Africheck, 2018). Women headed households are more vulnerable to poverty.

Within the smallholder sector, there are distinctions based on access to land, resources and agricultural activities pursued. The table below provides a typology of farming in South Africa, as an illustration of these differences.

Table 1: The agrarian structure of South Africa (Cousins, 2016)

Farmers	Numbers	Key features
Top 20% of large-scale commercial farmers on private land; almost all are white	7 000	Sophisticated, specialized, capital-intensive farmers, producing for export or for agro-processing and large retailers; produce bulk of produce, perhaps as much as 80%
Medium- to large-scale commercial farmers on private land; almost all are white	9,000	Some farmers succeed, some struggle, some are unable to earn a living from farming alone
Small- to medium-scale commercial farmers on private land; mostly white, some black	19,000	Many cannot survive from farming alone; includes hobby farmers
Small-scale black capitalist farmers in communal areas and in land reform contexts	5,000-10,000	Many farmers earn income from off-farm incomes and businesses in addition to farming
Market-oriented black smallholder farmers in communal areas and land reform contexts, supplying tight value chains (e.g. under contract)	5,000-10,000	Many grow fresh produce under irrigation, others are livestock producers, and a few engage in dryland cropping
Market-oriented black smallholder farmers in communal areas and land reform contexts, supplying loose value chains	200,000-250,000	Many grow fresh produce under irrigation, and others are livestock producers. Few depend wholly on farming
Subsistence-oriented smallholder farmers growing food for themselves, and selling occasionally	2 million-2.5 million	Most crop production takes place in homestead gardens, some of which are quite large. Occasional livestock sales by some

3.4.1 Smallholder farming systems

Within smallholder farming systems people practice a mixed farming approach and use available natural resources in the commonages. Access to resources (land, water and natural resources) depends to an extent on what and how much is available and on the local arrangements that are in place, which are managed through the traditional and local authorities. In theory, everyone has access; in practice this translates to those who can leverage resources through individual influence and resourcefulness.

Mixed farming in communal tenure areas consists of homestead plots, fields and communal grazing for livestock.

Homestead plots, as the word indicates, are situated around the farmers' homes and range in size from around 500 m^2 to around 0,5 hectares. These plots may or may not be fenced and in the more formally planned villages will have some access to a municipal supply of water. Water supply however is severely restricted in most cases to the municipal allocation of 20 litres per person per day – and only if that water is available. Shared, communal standpipes outside people's yards are the most common form of access to water. This means that for around 90% of smallholders, they only have access to as much water as they can carry to their homes on any given day. This water is used primarily for household needs. This means that dryland cropping is still common even within homestead plots and that more intensive productive activities such as vegetable and fruit production and rearing of small livestock usually is done only if additional sources of water can be accessed, either through the municipal systems, which is not common, or through access to springs and streams nearby. A very limited number of individuals have their own boreholes.

Fields are generally allocated to individuals and are often not in direct proximity to the homesteads. Sizes range from 0,1-5 ha, averaging around 1 ha in size. Historically these have been used primarily for field cropping grains (maize, sorghum, millet), pumpkin species and legumes (sugar beans). Fields may be fenced or unfenced and are worked by hand or by paying for private or government-based mechanisation services. At this scale, a number of group projects exist in the communal tenure areas and in some cases, projects run by government and non-government organisations have included irrigation options. A very small percentage (around 1-5%) of individuals have set up their own irrigation systems.

Communal grazing is managed on a village level and livestock are allowed to graze in and around the villages and fields in winter months and adjacent veld, bush and hillsides during summer. Individual smallholders often have kraals for their livestock and pay towards herding and dipping systems for their livestock. Mostly these systems apply to cattle and sheep. In the past goats were not herded, but due to increasing pressure on grazing areas and conflicts related to livestock destroying crops and gardens this is becoming more common. Rangeland management is notoriously difficult in these communal tenure areas and the quality and quantity of grazing appears to be in an almost continual decline. Systems for fodder production, supplementary feeding and rotational grazing are not widespread.

Natural resources are harvested extensively for firewood, thatch, reed and grass crafts, food (e.g. wild leafy greens) and medicinal purposes. Very few systems for control, management and regeneration of natural resources are currently in place and in addition wide scale poverty and population pressure in the communal tenure areas have led to overuse of resources and denuding of the commons.

In the author's experience, access to water for both household and agricultural purposes is considered the main limiting factor by smallholder farmers. The figure below outlines the typical average monthly water demand of a household. Most households receive around one fifth of this allocation of water.

Figure 9: Household water requirements and access (Kruger, 2016)

3.4.1.1 Climate change impacts on smallholder farming systems

The more extreme weather patterns with increased heat, decreased precipitation and more extreme rainfall events; increase of natural hazards such as floods, droughts, hailstorms and high winds that characterise climate change place additional pressure on smallholder farming systems and MDF has

found that this has already led to severe losses in crop and vegetable production and mortality in livestock. A significant proportion of smallholders have abandoned agricultural activities and this number is still on the increase. Smallholders are generally not well prepared for these more extreme weather conditions and experience high levels of increased vulnerability as a consequence (Manderson et al., 2016).

It is becoming clear that climate change will have drastic consequences for low-income and otherwise disadvantaged communities. Despite their vulnerability, these communities will have to make the most climate adaptations (Fenton et al., 2015). It is possible for individual smallholders to manage their agricultural and natural resources better and in a manner that could substantially reduce their risk and vulnerability generally and more specifically to climate change. Through a combination of best bet options in agroecology, water and soil conservation, water harvesting, conservation agriculture and rangeland management a measurable impact on livelihoods and increased productivity can be made (Hansford, 2010.)

3.5 LOCAL AND TRADITIONAL KNOWLEDGE IN CRA

Most of the CRA practices with which the project will be concerned are likely to be quite site-specific, which makes local and traditional knowledge extremely relevant for implementing such practices at a ground (community) level. It should be acknowledged that some of the CRA practices correspond with many existing local practices. Local and traditional knowledge is deeply embedded in many communities and the associated practices are considered cost effective and easy to scale out to other communities.

The literature indicates that for adoption of CRA practices to be successful it should be built on existing local and traditional knowledge (FAO, 2013). However, local understanding of the practices and reasons to take up a practice often differs to that in the scientific domain. It is important for development practitioners and researchers to have some understanding of the local and traditional knowledge to allow better implementation of improved practices (e.g. CRA practices). Building links between the scientific information and local and traditional knowledge presents a potential opportunity for developing a holistic approach for dealing with the negative impacts of climate change at community level. The Association for Water and Rural Development (AWARD) is implementing a programme to increase resilience in the Olifants River Basin – the approach, involving systemic social learning, is one example of this (Kruger and Selala, 2017) (AWARD, 2017).

It is important to note that the depths of such knowledge and the implementation of such practices varies considerably between communities in different areas across South Africa. In areas with a long continuous tradition of indigenous agricultural practices, such knowledge is strong and the practices well understood. Such areas include much of Limpopo Province, and the coastal sections of the former Transkei homeland in the Eastern Cape Province, historically inhabited by the amaPondo and amaThembu clans. However, in many other areas – such as those to which people were forcibly relocated during the establishment of the former homelands – there is not such a long continuous tradition and many of the farming practices have been derived from people's acquaintance, often as farm labourers, with the conventional agriculture practiced by the white commercial farmers. Even in these areas, however, it is possible to find traditional practices such as 'matamo' (construction of small ponds) or 'gelesha' (ripping the ground to improve infiltration, prior to planting) (Denison and Manona, 2007).

Communities are already needing to use local, traditional and indigenous knowledge to help cope with the negative impact of climate change. This includes knowledge of food preservation techniques (e.g. fermentation and sun drying), knowledge of indigenous plants (e.g. for use in natural pest control), seed selection to avoid drought and disease control in livestock. The list below shows some other local and traditional practices which correspond with CRA principles and practices:

- Seasonal weather forecasting (Use of shift in seasonal migration for birds as an indicator for weather forecasting)

- Selection of seed to avoid the risk of drought and pests
- Water harvesting techniques (e.g. roof water harvesting)
- Use of ash for seed preservation
- Soil and water conservation using planting basins, furrows and ridges
- Use of sunken and raised beds to accommodate for water holding capacity and soil types
- Mixed cropping or intercropping and diversification
- Use of supplementary feed for livestock
- Preservation of pasture for use by young, lactating and sick animals in cases of drought
- Transhumance to avoid risk of livestock loss
- Culling of weak livestock for food
- Diversification in the herd to survive climate extremes (Kruger and Selala, 2017).

CRA may provide a valuable opportunity to revive local and traditional knowledge and practices, as they have considerable potential for amelioration of some of the negative impacts of climate change on small-scale agriculture.

4 DECISION SUPPORT PROCESSES

This project aims to design a framework of methodologies, associated processes and a selection of best bet practices, informed by the issues that have been discussed, which can be used to assess, implement and monitor likely local CRA strategies. The practices themselves are discussed in the accompanying handbook.

Within the climate change community, decision support systems for climate smart agriculture options at a local level have thus far been designed in top-down processes – using climatic, geographic and demographic databases and information to select a range of appropriate practices on regional level as for example through USAID, Care International and FAO. Generally, a DSS is currently seen as a computer, or perhaps more saliently, internet-based system, which enables large amounts of diverse information to be analysed in order for managers to reach rational decisions.

A recent review, discusses the different types of models presently available and along with equation-, agent and geographic-based models, discusses more participatory models as well (Nay, Chu, Gallagher and Wright, 2014). Their conclusion is that it is advisable to adopt approaches incorporating both technical and social components in a DSS.

The Consultative Group for International Agricultural Research (CGIAR), has developed a decision support system for identifying appropriate CRA practices; described as a set of filters for evaluating CRA options & establishing CRA investment portfolios for National and sub-national decision makers donors, NGOs, implementers (CGIAR, 2017).

Here however, we are focussing the decision support process on a bottom-up approach, where individual farmers in a locality make decisions regarding the 'basket' of CRA approaches and practices most suited to their specific situation. To do this in a way that also includes the concepts of social learning, innovation and agency the following decision support concept has been developed.

4.1 WHAT GOES INTO THE CRA SMALL SCALE FARMER DECISION SUPPORT SYSTEM

Using a systemic approach and social learning from a socio-ecological perspective, the model consists of a number of layers of input parameters or filters used to define a basket of best bet CRA options for a specific smallholder farmer, using a combination of participatory processes linked to technical databases.

The process is designed to also support and assist the facilitator in their decision making, in support of the smallholder farmers; meaning that the facilitator accesses information such as the basic climate change predictions for the area, the agroecological characteristics including rainfall, temperature, soil texture, etc.) and an initial contextualised basket of CRA practices from which to negotiate prioritized practices with farmers. Practices are thus chosen by both facilitators and farmers.

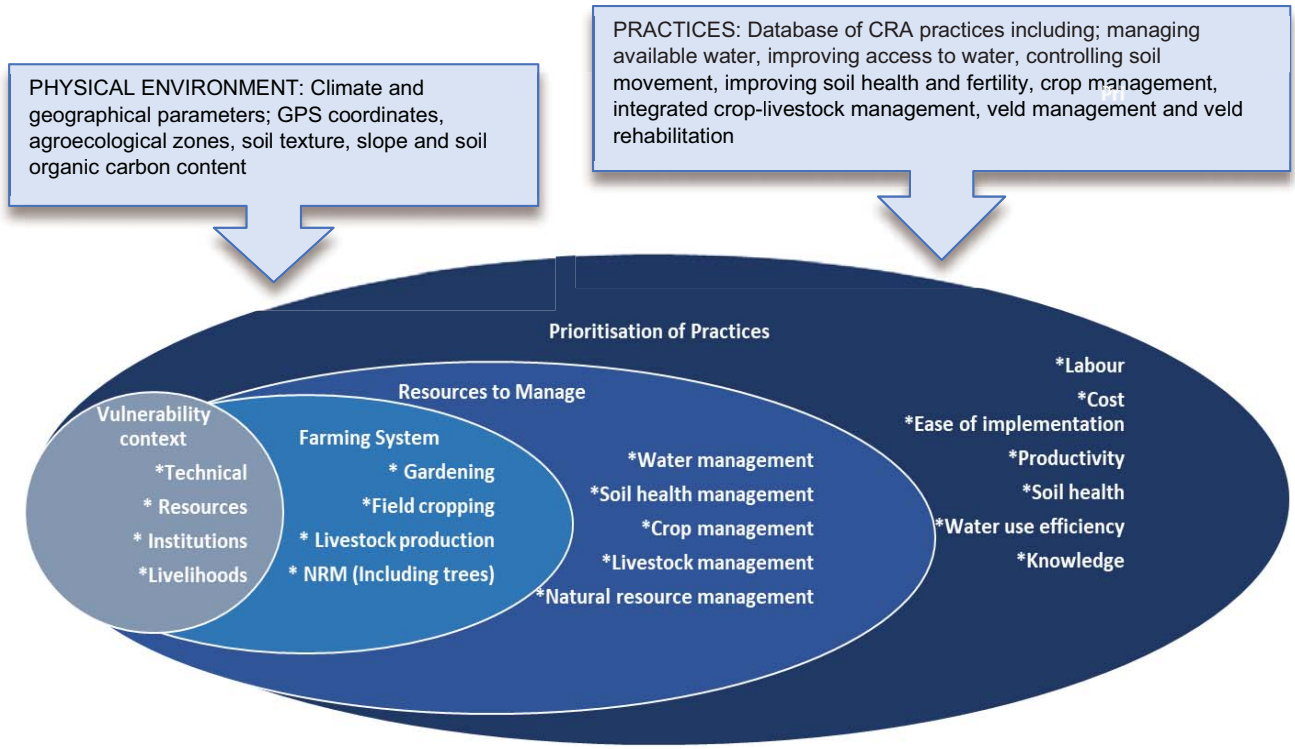


Figure 10: The Small-Scale Farmer Decision Support System

The model is designed primarily as a participatory and facilitated process at community level. In support of this process a computer-based model can be used alongside this methodology to provide further information and decisions support to the facilitator. It is also possible for a farmer to access this model independently to derive an initial basket of CRA practice options for themselves.

The computer model information flow is designed as shown in the figure below and follows the same basic steps as the facilitated model shown in Figure 10.

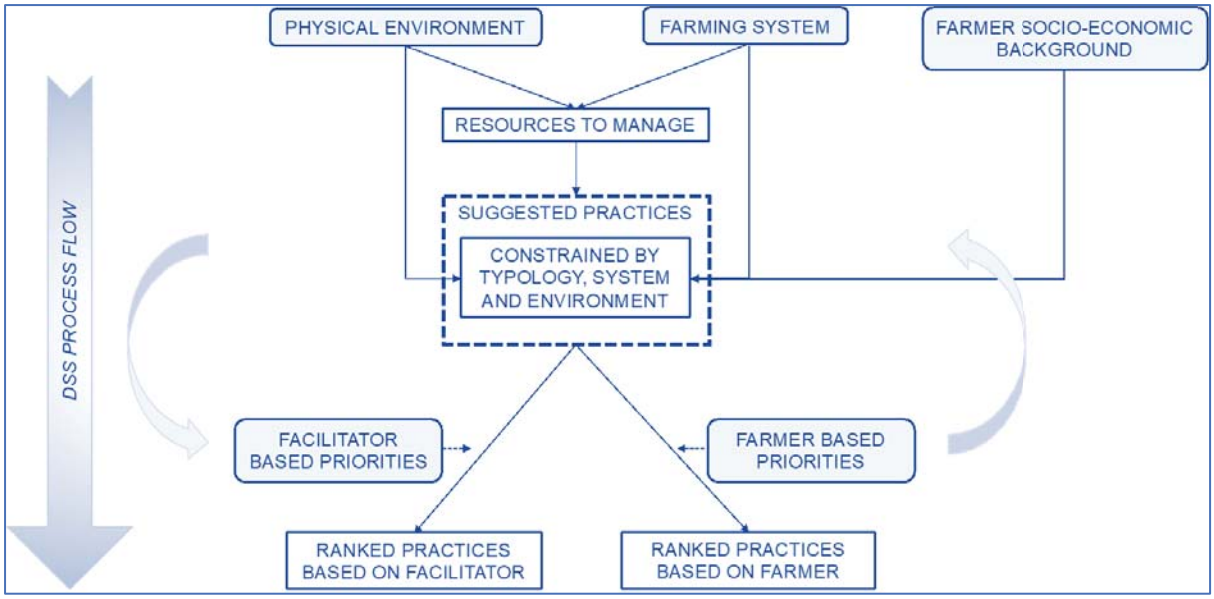


Figure 11: The computer-based model for the smallholder DSS

In our case the set of criteria (proxies used as indicators for the complex reality) that helps to make informed decisions on management practices are:

- The current farming systems; gardening, field cropping, livestock production and natural resource management (NRM) (including trees),
- The physical environment: agroecological zone, soil texture, slope and organic soil carbon and
- The socio-economic background of the farmer; demographic information (gender HH head, age, dependency ratio), level of education, sources of income (unemployment vs. external employment, own business, grants, farm, etc.), total income, access to services, infrastructure, technology (Electricity, water (tap, borehole, rainwater harvesting, etc.), irrigation (buckets, standpipes, etc.), fencing and farming tools (hand vs traction/other), social organisation, market access (formal vs. informal), farm size and farming purpose (food vs. selling).

Besides this, the resources and related management strategies as well as a list of practices need to be provided as input to the system. All information, except the physical environment; i.e. climate, soil and topography, and the resources and management strategies, are derived through the use of a range of participatory processes. Data on the physical environmental conditions have been taken from datasets freely available online. This information can however be customised by the DSS user, in case more appropriate information is available for the specific farmer concerned.

For the Facilitator-Farmer DSS the resources and related management strategies are discussed and negotiated in the participatory process. For the computer based or Individual Farmer DSS these are provided as an input into the model using the framework shown in Figure 12.

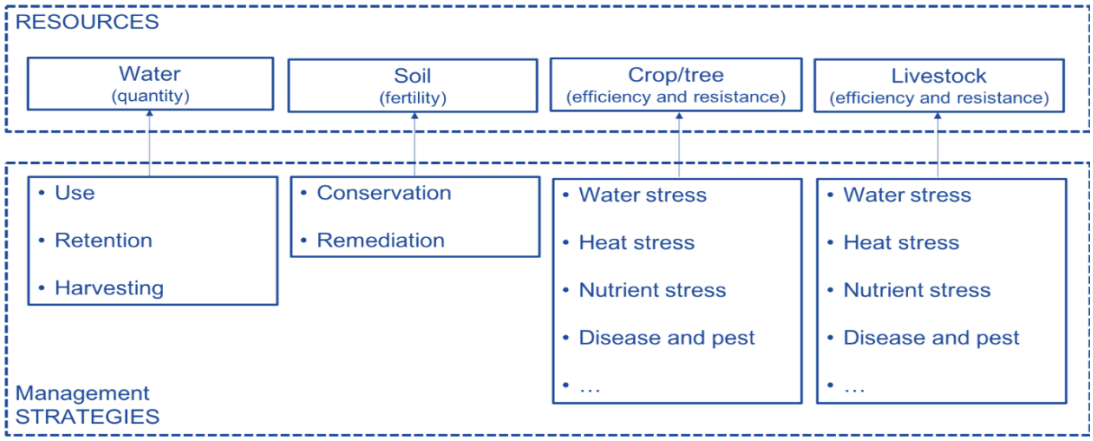
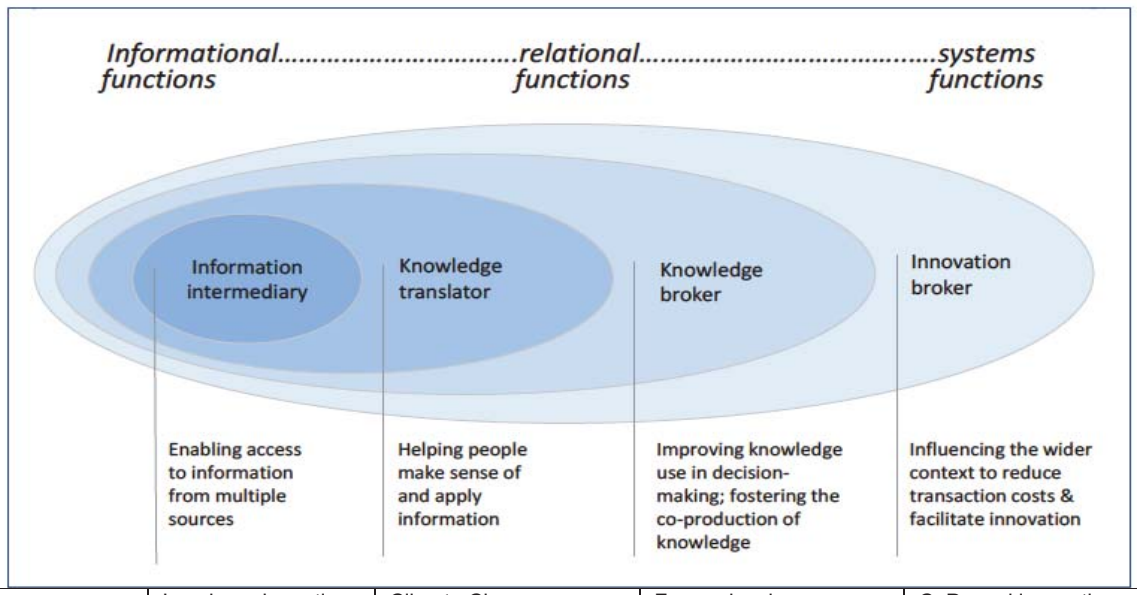


Figure 12: Resources to manage and their associated management strategies

The practices have been identified by both farmers and South African development experts, as well as desk top reviews.

4.2 How does the facilitator-farmer DSS work?

In effect, the DSS discussed above is a way of providing and making sense of information. This information is contextualised in a social learning system (a group of people learning and implementing together) using the framework shown in Figure 13.



Activities and processes	Local good practice	Climate Change	Farmer level experimentation to test practices	CoPs and innovation platforms
	Best practise options	Impacts of climate change	Introduction of new practices and ideas to try	Benchmarking for visual indicators
	Stakeholder engagements	Adaptive strategies	Learning and mentoring	
	Materials and information	Appropriate practices	Assessment of outcomes and impacts	
	internet based platform		Cyclical, iterative learning and implementation	
Facilitator-Farmer Decision Support System				

Figure 13: A systemic view of the Facilitator-Farmer DSS indicating associated activities and processes

The DSS thus incorporates the whole system of social learning and innovation, in an iterative process that can lead to social change and agency in climate change adaptation, as depicted in Figure 14.

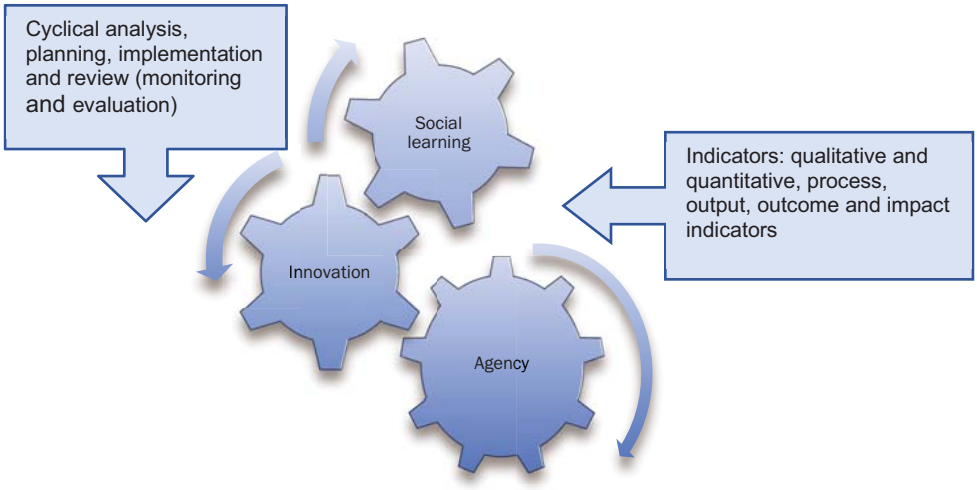


Figure 14: Social learning, innovation and building agency is an iterative process that includes careful monitoring and evaluation

5 HOW TO FACILITATE THE FACILITATOR-FARMER DSS

An assumption made is that entry into a community has already been made and that it is possible to arrange a community level meeting for interested participants.

This means that an introductory workshop explaining the process would need to be held first, before launching into the short series of 3 climate change adaptation (CCA) workshops. The intention of these workshops is also to create and strengthen the learning group, to enable the social learning process to unfold.

In addition, as baseline survey is important to understand the existing conditions in the locality. These baselines also provide the information for the individual DSS process in terms of the environmental conditions and vulnerability criteria for the individual (socio-economic criteria and typology).

5.1 BASELINE SURVEY

Generally, this is done during the 1st CCA workshop when individual household visits are undertaken, but can also be a stand-alone exercise conducted at the beginning of a CRA intervention

5.1.1 The baseline survey questionnaire

Date			Area		
Village			GPS		
Surname			First name		
Cell no					
ID number					
Gender	♀	♂	Household head (Y/N)		
Education					
Members of Social organisation/s (describe), e.g. savings group, learning group, etc.)					
No of Adults in household (HH)					
No of children					
Income sources (grants, employment, remittances, other – specify)			Level of income – monthly per household)		
Type of grant (s) – add in no	Child Support		Old Age		Foster care
Scale of operation	0,1-1 ha		1-2 ha		>2 ha

Farming activities	Garden (size)	Fields (size)	Livestock (No) Cattle Goats Chickens Other:	Nat resources – specify Trees Indigenous plants
Resources and infrastructure	Water (list – tick and describe) – tap – standpipe – RWH – Other	HH infrastructure – dwellings – electricity – fencing – other	Farming infrastructure and tools (list	Other
Other livelihood activities (list)				
Market access (describe)				
Training and advice (Name sources of support)				

5.1.2 Example of a baseline survey

The responses to these questionnaires can be input into an excel sheet and coded to be able to summarise information from a number of different participants and get an indication of the 'profile' of the participants involved. Below are two bar charts summarising information for 41 participants across 7 villages in KZN, EC and Limpopo as an example. The charts summarise the livelihoods and resource indicators of the questionnaires.

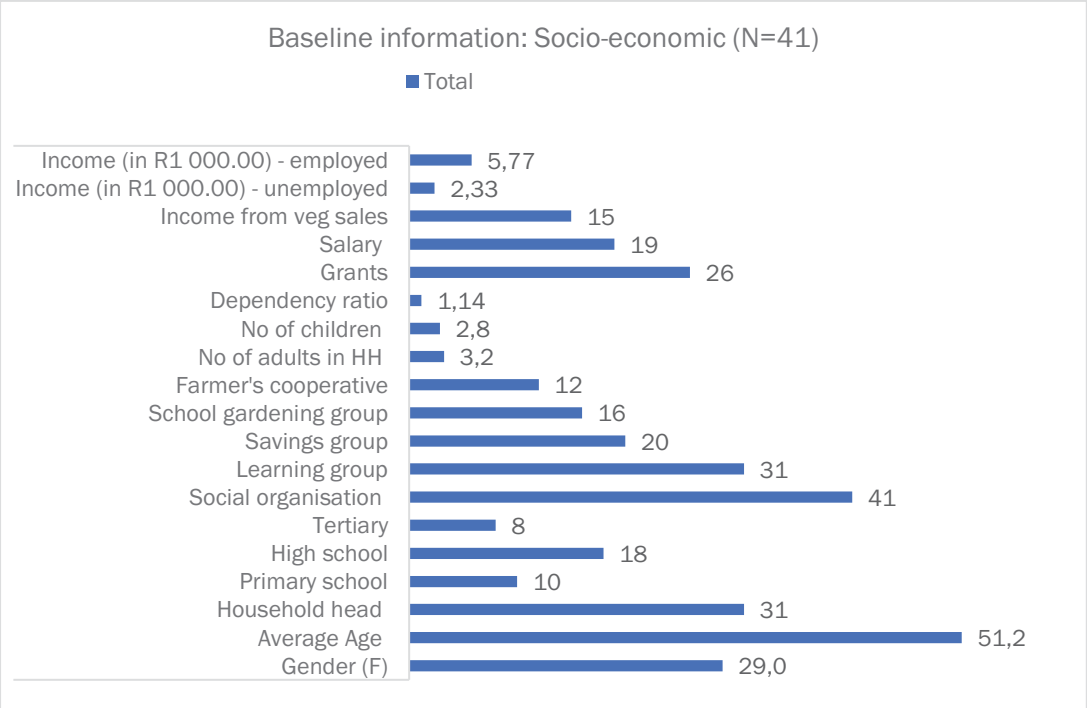


Figure 15: Socio-economic baseline information from a survey conducted for 41 participants (April 2019

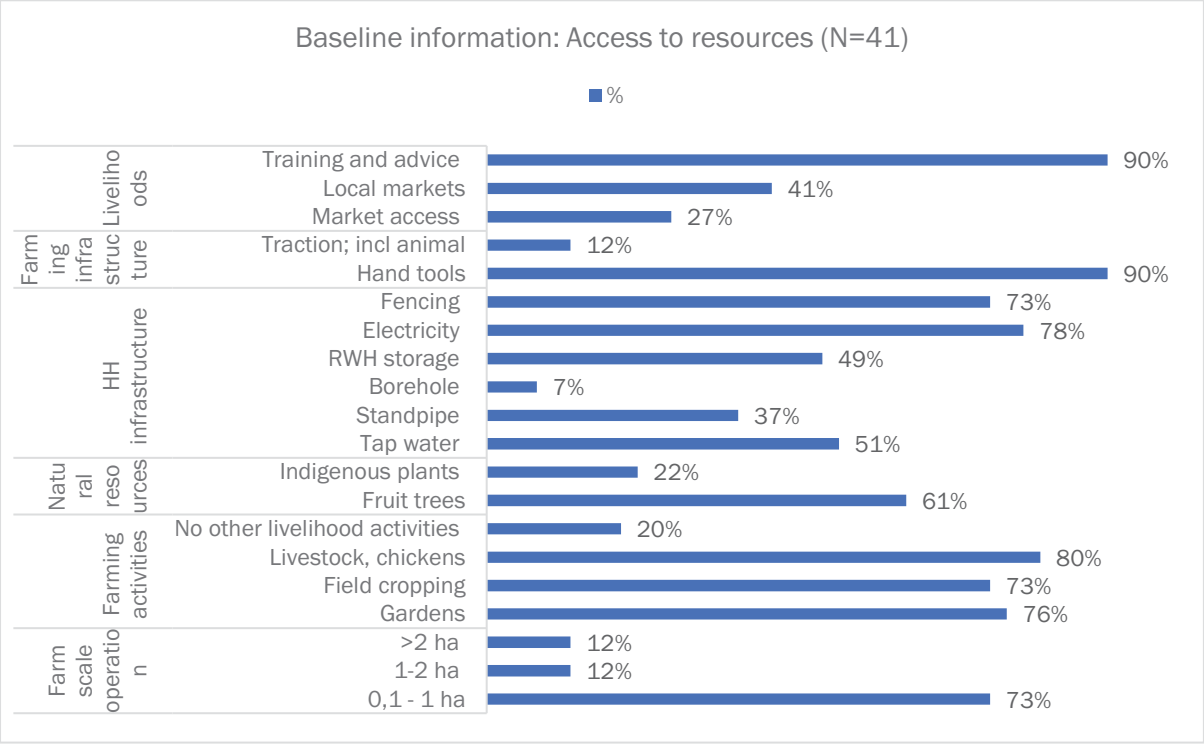


Figure 16: Access to resources, indicated as a percentage for 41 participants (April 2019)

5.2 COMMUNITY LEVEL CLIMATE CHANGE ADAPTATION ANALYSIS – OUTLINE OF THE 3 WORKSHOPS

In these community level workshops/dialogues facilitation tools have been designed that can assist in the analysis. A number of different tools have been designed for the following explorations/workshop activities: Differentiating between weather and climate change, unpacking changes in the environment

and livelihoods, assessing those most affected by climate change, exploring impacts of climate change and exploring current practices and adaptations already being implemented to respond to these changes.

Below is a chronology of steps or processes to be undertaken at community level, assuming there is already some level of relationship and interest**.** These steps work towards building a CoP /learning group:

- Understanding climate change and impact (academic understanding, community understanding)
- Climate change and agriculture (farmers' roles and responsibilities, current practices/challenges)
- Changes, reasons and responses (what are we doing already, what do we think we can do that will help, willingness to change)
- Discussions around change (most important problems, what do we foresee in the future based on what we are doing, effectiveness of our adaptation responses)
- Who do we want to work with (outside organisations, local institutions, learning groups, other community organisations? Are there new relationships or new ways of working together that can help)
- Is anyone doing new and interesting things (local innovations to consider – what has been tried and how well has it worked?)
- Introduction of practices:
    - Reality map (present agricultural practices and impact)
    - Walk about in village
    - Desktop review for appropriate practices or to research practices suggested by participants
    - Focus group discussions
    - Prioritising (defining criteria)
    - Practices that mostly match criteria (short visual introductions for likely doable practices in the area, introduce about 5 practices – facilitator's judgement call) Link to local practices
    - Ranking exercise linking criteria to practices
    - Learning group members choose practices they would like to implement or experiment with. This could mean:
        - Subgroups dealing with different topics (e.g. gardens, fields livestock)
        - Whole learning group doing practices in succession (e.g. start with gardens first)
        - Defining a chronology of activities, e.g. start with trench beds and mulching, then implement diversion ditches and stone bunds, etc.
        - Individuals choose an initial set of 5 practices for example and then upon review decide how to build on that in a following season.
    - Implementation, training and mentoring, demos, cross visits, specialists (sources of expertise), lead farmers
    - Monitoring and review.

5.3 CCA WORKSHOP 1: CLIMATE CHANGE ANALYSIS – IMPACT AND ADAPTIVE MEASURES

This workshop runs over a period of two days.

Facilitation steps proposed are as follows:

1. Contextualization: Natural resources (facilitators need to look at provincial climate change databases before the workshop and discuss with people how these will affect them). Facilitation tools for this exercise include: A4 impact pictures or a PP presentation – of floods, droughts, erosion, declining natural resource base, declining yields, etc.)

2. Look at the difference between variability in weather and climate change. Facilitation tools for this exercise include: A climate change role play
3. Exploration of temperature and rainfall and participants' understanding of how these are changing. Facilitation tools for this exercise include: Seasonal diagrams on temperature and rainfall – normal and how these are changing
4. Timeline in terms of agriculture. Facilitation tools for this exercise include: Livelihoods and farming timelines – assessment of past, present and future
5. Reality Map: Changes (in natural resources), impacts (of changes), practices (past, present, future) and challenges/responses. Facilitation tools for this exercise include the climate change impact mind mapping exercise
6. Current practices and responses (effectiveness of responses). Facilitation tools for this exercise include outlining adaptive measures on mind map and doing matrix ranking exercise for different adaptive measures.

Using these facilitation steps a workshop process has been designed and tested. Below is a summary of the workshop outline followed by short descriptions of the facilitation tools.

5.3.1 Outline of the two-day workshop

Community level climate change adaptation exploration workshop outline					
DAY 1					
Time	**Activity**	**Process**	**Notes**	**Materials**	**Who**
9:00am	**INTRODUCTION**				
9:00-9:45am	Community and team introductions	In pairs, take 5 minutes to talk to each other. Then introduce each other to the group. Choose a person you don't know well (both team and community). [include Name and surname, farming activities (garden, field, livestock natural resources), income from farming]	Depending on the size of the group, this can take a long time. If time is short, then just do a quick round of introductions.	**Attendance register** – with columns for farming enterprises (so that each participant can tick what they do) – in English and Zulu/Pedi. **Name tags;** stickers, kokis	**Materials and logistics:** **Facilitation:** **Recording:**
	Purpose of the day	Introduction of the organisation/s and purpose of this workshop – link to already ongoing activities if possible and introduce visitors and other stakeholders involved	Talk to CC necessitating adaptation from us – we may need to change how we do things and what we do to – This w/s is to help us explore options for such changes	Flip stand, newsprint, kokis, data projector, screen, extension cables, plugs – double adaptors. Black refuse bags and masking tape (for blacking out windows), camera – and one person to undertake to take **photos** throughout the day. Extra batteries for camera and sim card	**Materials and logistics:** **Facilitation:** **Recording:**
9:50am	**PRESENT SITUATION**				

9:50-10:30am	Present livelihoods and farming situation – discuss impacts related to CC	Use a series of impact pictures – from the local situation. Include the 5 categories (and describe them to the group) – water management (increased efficiency and access), soil management (erosion control, fertility, health), crops, livestock and natural resources	Impact pictures – either PPT or printed on A4 to facilitate dialogue (or both). Record community comments)	**Power point presentation pictures**	**PPT** : **Facilitation**:
10:30am	**PAST, PRESENT, FUTURE**				
10:30-11:30am	Discuss farming activities as they have changed, what they are now and what may happen in the future if the present trends continue	SMALL GROUPS (5-10 people): facilitated discussion on farming activities (include the 5 categories) – prompt for all five and keep conversation focussed OR Facilitate a shorter plenary discussion on how things are changing (if time is pressing)	Important to note and record any discussions around changes and adaptations – so things people are already doing to accommodate for changes – also where they are not sure what to do	Small groups; each needs a facilitator and recorder	**Facilitation**: **Recording**:
11:30am-12:00pm	**TEA**	Fruit (apples, oranges, biscuits, juice and water, paper cups (lots) and plates… Generous helpings – and lots of juice if it is hot. Find someone to be in charge of food and refreshments, while the rest of the workshop continues			
12:00am	**CLIMATE CHANGE PREDICTIONS**				
12:00-12:50pm	Summary of predictions for the locality (from scientific basis) [15 min]	Present to group – using flipchart or power point – Keep it simple with brief bold statements that can be remembered. Include concepts of certainty – and CC scenarios – unmitigated, neutral and mitigated			**Facilitation:** **Recording:**
	Weather vs Climate [10 min]	Role play; phone conversation – weekend visit for weather, relocating to an area for seasonality/climate.	Check in with participants how they understand the difference from the role play		**Facilitation:**
	Seasonality diagrams [25 min]	SMALL GROUPS (5-10 people): facilitated discussion on temperatures for each month of the year – in a normal year and then discuss how this is changing and going to change. Start with the hottest month and then the coldest month as reference points	Do temperature first or if the group is small and works quickly include rainfall then on the same chart.	Easy to use kebab sticks bought from supermarket for this. Small groups; each needs a facilitator and recorder	**Facilitation**: **Recording**:
1:00pm	**REALITY/IMPACT MAPS**				

1:00-2:00pm	Impact of CC mind map	SMALL GROUPS (5-10 people): facilitated discussion – MIND MAP of livelihood and farming impacts (using the 5 categories) using Hotter (drier) as the starting point – LINKAGES between cards on the mind map – make arrows (and include more cards if need be and discuss (e.g. hotter soils, lead to poor germination lead to poor yields lead to hunger)	Prompt for social, economic, environmental impacts as well if these don't come up in the group…	Small groups; each needs a **facilitator and recorder**	**Facilitation**: **Recording**:
2:00-2:30pm	Possible adaptive measures	POSSIBLE SOLUTIONS: things that people know, have changed, have tried and or are trying, to deal with the changes. Use different coloured cards to attach these solutions to the mind map. If participants are struggling then rephrase the -ve impact statements into a +ve outcome and ask what actions are possible.	Also make a separate list on newsprint of names of people trying things plus the innovation they are trying (this is to facilitate h/h visits on day 2)	The cards need to be written in local language with smaller translations in English written in on the cards as well (to avoid the need for later translations)	**Facilitation**: **Recording**:
2:30-2:45pm	**CLOSURE**	REPORT BACKS – of possible solutions PLANNING FOR DAY 2 – choose 3-4 participants for household visits and ask for a small group of other interested individuals to join. Decide on venue and time (12 noon) for continuing with practices	Households to be within walking distance hopefully. Otherwise drive these 3-4 participants around and meet for focus group thereafter	Rapporteurs need to be chosen from the group to summarise the solutions in the report backs [5 min/group]	**Facilitation**: **Recording**:
	LUNCH Local catering groups to provide meals – ~R45 per head (Rice and stew with one veg… or something similar)				
DAY 2					
9:00am	**HOUSEHOLD VISITS**				

9:00 am-12:00pm		To look at local adaptations and innovations To assess the household situations To start to elucidate criteria people use to make choices and decisions	Use questionnaire and fill in through semi structured interview and observations	Questionnaires to contain the following info: • Head of household (male/female) • No of adults • No of children (dependency ratio) • Income sources • Level of income • Scale of operation: 0,1-1 ha, 1-2 ha, > 2 ha • Farming activities: Gardens, fields, livestock ,trees • Market access • Other activities • Resources • Water access • Infrastructure • Knowledge and skills • Literacy rate • Social organisation	**Facilitation**: **Recording**:
		Team meets in evening (BEFORE DAY 2) to discuss mind maps and lists of solutions and choose a range of practices from the database to present (5-10). Also, summarise criteria that came from the household visit discussions.			
	TEA	Packed tea for on the go to share with household members			
12:00	**PRACTICES**				
12:00-1:00pm	New ideas/ practices/ innovations	Recap and summary of day 1 Introduce a selection of new practices _power point and A4s (chosen the night before by facilitation team to match the general sense of what participants need ideas for or what they are trying (to improve upon those). Provide descriptions and get questions and comments	Select the 5-10 practices beforehand and make sure there are 3-4 copies of the A4s for the small groups and or a power point presentation – **record comments from participants**	Sets of practices (A 4s), attendance registers	**Materials and logistics:** **Facilitation:** **Recording:**
1:00-1:20pm	Criteria for selection of practices	In plenary present criteria, discuss with group and add more (prompt for criteria to relate to five categories (e.g. saving and using water well, increasing access to water, improving organic matter, increasing soil health, increasing natural resources.... etc.) along with criteria like cost, labour, time....	Choose 5-7/8 criteria max. Some criteria can be made from two into one…	Flipchart, newsprint, kokis	**Facilitation**: **Recording**:

1:20-2:00pm	Prioritization of practices	SMALL GROUPS: Choose a selection of practices from their own suggestions and new ideas presented (5-10) and assess them using the criteria chosen in a matrix.	Let the group decide for each square using a scale of 0-2 where 0 = bad or little, 1 = ok to medium and 2 = a lot to good.	Newsprint, kokis. Small group facilitator and recorder	**Facilitation**: **Recording**:
2:00pm	**WAY FORWARD**				
2:00-2:30pm	Each individual choses their practices Set up sessions in the coming months to refine choices and start on demonstrations and training in implementation of practices and farmer experimentation Choose 'volunteers' for joint /group experimentation per site		Learning sessions	Put together a list for each small group for each individual to record their name, surname, tel /cell phone and practices	**Facilitation**: **Recording**:
	LUNCH Local catering groups to provide meals – (Rice and stew with one veg… or something similar)				

CLIMATE CHANGE PREDICTIONS:			
Hotter	1-4 degrees Celsius	For every month of the year	HIGH probability/ Certainty
Less rain	Similar amount of rain but over a shorter period of time (fewer rainy days per season)	This will lead to an overall drying effect in the environment	MEDIUM certainty
	Greater intensity of rainfall		
	More rain in spring and or more rain in summer	Storms	LOW certainty
Longer term	Greater frequency of droughts under scenarios 1 and 2		Scenario 1 – Business as usual; Scenario 2 – Stabilise emissions; Scenario 3 – Reduce emissions
	Greater frequency of extreme rainfall events under scenarios 1 and 2		

5.3.2 Facilitation tools

5.3.2.1 The weather and climate roleplay

Requirements: Two co-facilitators prepare a small role play of a telephone conversation beforehand.

Aim: To explore as a group the difference in concepts of weather and climate

Activity: A small role play of a telephone conversation is prepared and presented (no more than 5 min) in two parts – one where a conversation about the weather is presented and the second, a short conversation about climate. The group is asked how this conversation shows the difference between weather and climate and what they think it means.

1. The facilitator opens the session by acknowledging how most of us have now heard stories of "climate change", what it is, what it concerns. It can be very confusing. Therefore, it is important to create an understanding of what climate is and how it is different from weather.

2. The facilitator introduces the concept of weather, as the familiar concept we encounter every day and consider in short timeframes, e.g. we can't know what the weather will be like in a month's time, but we can have a pretty good idea what the weather will be like tomorrow. The facilitator then introduces the telephone role play around the weather and two co-facilitators do a quick role-play.

    a. Co-facilitator A: [Calling] *Hi Phindile!*

b. Co-facilitator B: *Hi Itumeleng*
c. Co-facilitator A: *I am going to come visit you in [village name] for the weekend. What is the weather like? What should I wear?*
d. Co-facilitator B: *It's going to be a bit cold this weekend, so bring a warm jacket, some jeans and socks*

3. The facilitator introduces the concept of climate, noting that it is the patterns of temperature and rainfall over a long period of time and again introduced the telephone role play:

    a. Co-facilitator A: [Calling] *Hi Phindile!*
    b. Co-facilitator B: *Hi Itumeleng*
    c. Co-facilitator A: *I'm really looking forward to moving to [village name]. I'm currently sorting out my packing. What kind of clothes should I pack seeing that I will be living there for at least the next few years? What are your summers and winters typically like?*
    d. Co-facilitator B: *We'll, we have long hot wet summers so pack lots of t-shirts and an umbrella. The winters aren't that cold though. So, no need for a lot of thick jackets.*
4. The facilitator asks for comments from participants about what they saw and how they understand the difference between weather and climate.

5.3.2.2 Climate impact overview in pictures

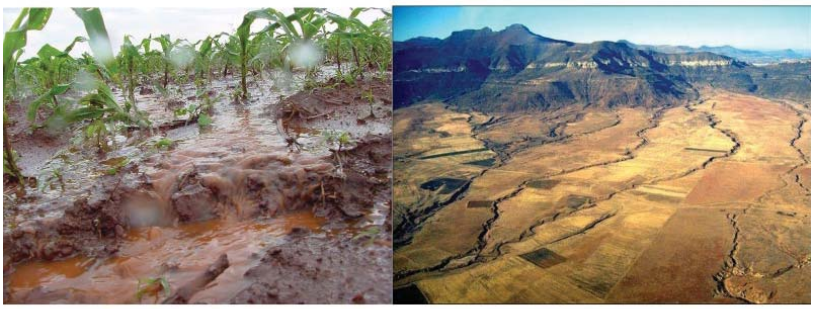
This is a session where the facilitator provides the context for the process of working in climate change adaptation and discusses with participants some of the impacts of climate and climate variability on their environment. It is best to collect photographs relevant to the participants and the locality, where they can easily recognise their area.

Below are a few examples.

Soil erosion; due to bare soil and ploughing, increased with hot dry weather, drought, high winds

Bloemfontein, Oct 2014 — Same day in Gauteng- the dust cloud rolled over Johannesburg

Soil erosion due to water- run-off: Loss of top soil in fields, and creation of gulleys and dongas



(from H. Smith, 2018)

5.3.2.3 Seasonality diagrams for temperature and rainfall

Requirements: A1 newsprint paper, kokis and a selection of thin sticks that can be broken into different lengths easily. One can buy kebab sticks from a local supermarket, if it is difficult to collect thin straight sticks in the area.

Aim: to explore participants' experience of a changing climate

Activity: To explore with participants their understanding of rainfall and temperature in a **typical** year in their areas and then to overlay on this typical year the changes they have been experiencing.

5.3.2.3.1 Temperature Seasonality Diagram

1. Participants break into small groups of 5-10 participants. It will be very helpful if participants can be in groups with others who work/live in the same area as they do. This is because rainfall patterns and temperature can differ quite substantially from area to area.

2. Temperature chart for a typical year:
   2.1. The facilitator draws an x and y axis on a blank flipchart, and asks the participants: *How many months are there in the year? Can you please write down the months evenly spaced along this line (indicating the x axis)?*
   2.2. The facilitator begins to discuss temperatures by asking the following*: In this area where you work/live, which month is typically the hottest month? Which month is typically the coldest month?*

   2.3. The facilitator asks participants to use the sticks to represent the temperature, using a short stick to indicate the coldest month and a long stick to indicate the hottest month. All other months fall between the shortest and longest stick

   2.4. Continue with the process by guiding participants to put in sticks to represent the temperatures of the other months. For example, ask: *Is January hotter than February but cooler than December? If so, then January will have a longer stick than February, but a shorter stick than December, correct?*

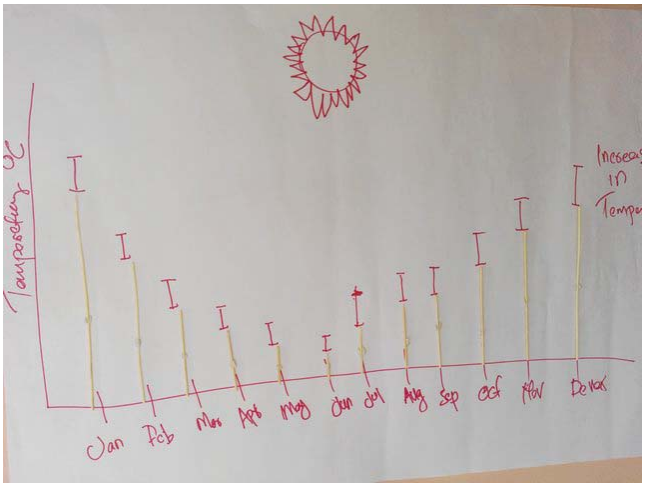
Notes:

- The chart should reflect a typical year, and not necessarily the past/current year.
- The chart does not have to be perfectly accurate (e.g. actual measurements of ˚C). Rather, it is based on the impressions and lived experiences of participants. Here, we are using sticks to indicate the relative difference of average temperature between months.
- There are no right or wrong answers, even when there are disagreements.
- All participants should reach an agreement that the chart now roughly represents monthly temperatures in a typical year in their area. Some may not agree at all. Acknowledge this difference, but ask them if it would be okay to accept the chart as is just for the sake of going through the exercise.

3. Temperature chart under climate change:
   3.1. Participants can be asked how much the temperature is increasing in each month and this can be added by drawing in a line with koki above the stick for each month. If the participants are not confident here, then the facilitator demonstrates how the temperature increases for all the months (i.e. it gets hotter). Note that the approach is that of "show-and-tell" instead of asking prompting questions.

Note: This part of the exercise shows in a tangible way what it would look like if the average temperature increases for all seasons. Again, this additional length does not need to be super accurate. As long as it demonstrates that when we speak about "average temperatures increasing by 2˚C", this means that every month will likely be a bit hotter.

On the right is an example of a temperature seasonal diagram produced in Limpopo (AWARD AgriSi programme, 2018)



5.3.2.3.2 Rainfall seasonality diagram

1. Rainfall chart for a typical year:

This chart follows the same process as the one produced for temperature; where the months are written on the x-axis and the amount of rainfall for a typical year, is depicted with different lengths of sticks.

2. Rainfall chart under climate change:

   2.1. The facilitator introduces climate change by giving the following explanation: Climate change can mean various changes to the rainfall. One possible change is the timing of rainfall being shifted later. For example, some of the rain in October/November may only come in December… (While explaining this, facilitator takes the stick for, e.g. November and breaks a piece off to add to December)
   …and the rainy season may end earlier (While explaining this, facilitator takes the stick for, e.g. April and breaks a piece off to add to March., or removes it entirely if there is no rainfall).

   2.2. The facilitator asks the following question: How do these changes affect the pattern of rainfall? And explains further that the rainfall amount for the year may stay the same, but it is concentrated in fewer months and another possible change is that there could be more rainfall (While explaining this, the facilitator adds a bar to the likely month where rainfall is increased, to lengthen the sticks, similar to what was done with temperature)

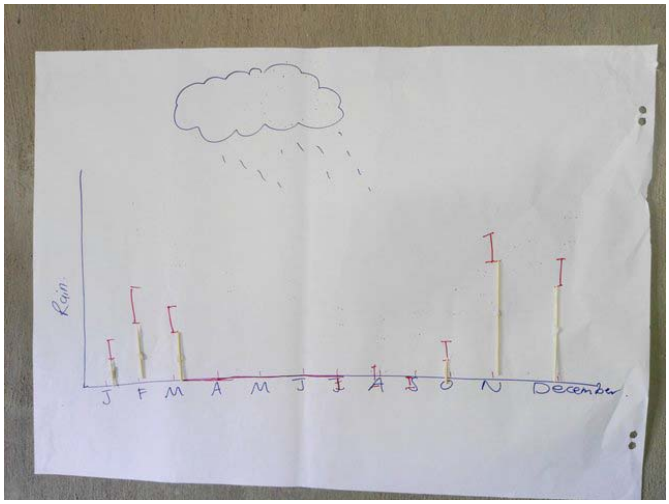
   2.3. The facilitator wraps-up this part of the activity by stating: With rainfall, there are multiple ways that it can change. This presents a special challenge. Why? Because we have to consider multiple scenarios instead of one. For example, we need to address both dry periods and flooding.

Notes:

- This exercise should show how rainfall patterns and distribution can change and not necessarily just the volume of annual rainfall. For example, demonstrate how rainfall can be concentrated into fewer months with more extended dry periods between "wet" seasons.
- Use words like could or likely instead of will.
- Remember that we are not trying to communicate an accurate prediction here (i.e. "this is how your rainfall will decrease in the future"). Rather, we are trying to demonstrate how rainfall patterns could change from how they are now.
- If participants ask if climate change will "cause more drought and/or floods" or "increase/decrease rainfall", then you can say at a global level, warmer climate is expected to increase extreme events such as droughts and floods, but these changes may not happen everywhere in South Africa because it has very diverse climate.

On the right is an example of a rainfall seasonal diagram produced in Limpopo (AWARD AgriSi programme, 2018). Note that the rainfall under climate change is likely to increase in some of the

summer months, decrease in winter months and that a longer period without rainfall is likely (the red line stretching from April-September)



5.3.2.3.3 Plenary discussion

As groups complete their charts, these are pasted onto the wall for all to see. When the charts are completed, the facilitator asks: We've talked about what climate change could look like, how it can change what we now see as a "typical year" regarding temperature and rainfall. Reflecting on this, how do you think this change will impact you and your work?

With this question, the facilitator leads the group into the next activity.

5.3.2.4 Timeline of farming activities

Requirements: A1 newsprint paper and kokis

Aim: This exercise is designed for participants to explore their farming practices and how these have changed over time, as well as trends into the future. This exercise helps to unpack trends in farming, issues with management practices and to pin point areas where immedaite activity is required.

Activity: Brainstorm in plenary, with recording undertaken by the facilitator

1. The facilitator asks: In the past (10-20years ago) what did your farming look like? What did you do? How did you live? And records a summary of the responses on newsprint
2. The facilitator then asks*: And now in the present what does your farming look like? What has changed?* And records a summary of the responses on newsprint
3. And then the facilitator asks: If these changes continue what will farming and your lives look like in the future (10-20yrs from now)?

Notes:

- The facilitator needs to dig deeper into some of the issues coming up and also ensure that the group as a whole participates and remains engaged in the conversation. If for example a participant makes a statement such as "Now there is less grazing for cattle", the facilitator needs to probe, and ask why? – Are there more cattle, has the quality of grazing changed, has grazing reduced due to climatic conditions, is there less access to grazing areas and so on.
- It is important to elucidate and clearly show trends that are taking place and also, with the help of participants, to understand if such trends are negative or positive and whether a change in practices can ameliorate such trends.

Example: Timeline for environmental and farming conditions for Madzikane, Creighton, KZN, 2019

PAST CONDITIONS	PRESENT CONDITIONS	FUTURE CONDITIONS
Hot temperatures	Increasingly hot temperatures during summer months	Temperatures will continue to increase drying out vegetable plants (tomatoes, green peppers)
Longer rain season	Shorter rainfall season and frequent droughts	Less rain & no rain fall in some seasons
Strong winds	Frequent and stronger winds that wreck peoples' homes	Less water infiltration in soil

PAST CONDITIONS	PRESENT CONDITIONS	FUTURE CONDITIONS
Low yields	Increased yields as a result of sustainable agriculture practices	Yields will decrease if farmers do not act against climate change
Tillage	No tillage and less use of tractors	No tillage and hand planting
Livestock controlled and regulated	No livestock control and regulation	Fencing of farm fields to control livestock grazing
Mix cropping	Single cropping	Mixed cropping and intercropping
Hand weeding	Use of pesticides and herbicides	Increased use of pesticides and herbicides
Soil erosion due to flooding	Increasing incidences of floods that lead to washing away of seeds	Vast and increasing soil erosion that may lead to farmers' inability to farm
Large farm fields	Smaller farm fields	Even smaller farm fields

5.3.2.5 Climate change impact mind mapping

Requirements: A1 newsprint paper, kokis and a selection of squares of different coloured paper

Aim: This exercise is designed for participants to explore all the impacts on their farming systems and livelihoods as a starting point to beginning to identify potential adaptive measures

Activity: Brainstorm in a small group all impacts (including individual, social, economic, health, environment, farming, etc.) and potential adaptive measures, both those participants are already using and are thinking about**.**

1. Participants are divided into small groups (maximum 8 participants). To start the mind mapping exercise one key entry point is chosen – usually in the South African context increased temperature is a good option and something that almost everyone has already experienced.

2. The facilitator asks: We've talked about what climate change could look like, how it can change what we now see as a "typical year". Reflecting on this, how do you think increased temperatures could affect your lives and farming? Participants are given a few minutes to write/draw these impacts on the yellow cards.

   2.1. The facilitator asks each participant to choose their top 5 impacts, the 5 impacts that are most important to them.

   2.2. Each participant is given the opportunity to describe one impact and why it is important to them. After each description, place the card on the flipchart (but do not yet arrange or draw links between the cards).

   2.3 Continue to go around the group until all participants have described their top 5 impacts.

3. With all impacts now on the flipchart, briefly discuss these impacts while arranging impacts according to how they are similar, or are linked. Arrange the cards accordingly, but do not yet draw linkages.

4. If there are concepts that were missing in what the participants describe, ask the participants to write out those concepts in additional cards, one concept per card. The facilitator can refer back to the impact pictures presented earlier to jog participants' memories and to include as many different aspects as possible. For example; the facilitator asks what about drought and or floods – what are the impacts linked to this? Or what are impacts linked to denuded soil and grazing areas? And so on.

5. The facilitator asks participants to describe **the linkages between the impacts**, and draw in these linkages and to elaborate on causes (what caused what).

6. **Exploration of potential adaptation actions:** The facilitator asks: Looking at the cards, can you think of actions to cope with or adapt to these threats? Or are there actions or measures that you have already been taking? Write these ideas down on cards, one idea per card (use a different colour paper than was used for the impacts). Another potential question could be: How can you change the management of a resource such as water, soil, veld, to ensure that it remains a good resource?

Notes:

- This exercise works quite well for groups where they have already been implementing certain interventions related to increased soil and water conservation and sustainable farming practices. If a project is already underway part of the climate change introductory discussion should refer to practices that have been introduced that could be considered adaptive measures; e.g. mulching, efficient irrigation, crop diversification and so on.
- If participants come from a group or an area where they have not thought about this before, the initial list of suggested adaptive measures may be quite short. They may also say that they do not have any ideas, but may expect support from the facilitator and or Government. Participants are likely to believe that if they have more access to resources (more money, more seed, more equipment for example) that they could adapt to the changes in climate. It is important for the facilitator to acknowledge this, but to add that changes in how resources are managed are equally if not more important than resources themselves.

6.1 Each participant gets to present two cards and explain the actions, which threat the actions addresses and how the actions address the threat.

6.2 As additional conversation pieces, the facilitator can introduce the flooding and drought pictures to discuss the additional complexity of extreme events.

6.3 At the end of this activity, the group takes a few minutes to decide what key point from their discussion and which three adaptation actions they want their representative to report back on during plenary.

On the right is the mind map produced by one of the small groups in Sekororo, Limpopo (2018). Blue cards show the impacts and yellow and pink cards the potential adaptive measures.

Participants mentioned impacts such as:

- More drought and floods
- Heavy winds and more storms
- Increased veld fires
- Scarcity of water; drop in boreholes and rivers drying out.
- Decrease in wetlands and natural vegetation – specifically trees.
- Having to produce crops in smaller areas
- Condition of roads deteriorates rapidly
- More wild animals moving into the homesteads and
- Social issues such as increased hunger, increased crime, lack of jobs, increased domestic violence, theft, divorce, no money to pay lobola, increase in death rate.

5.3.3 Household visits

This is part of day 2 of the 1st workshop. The idea is to do a bit of a transect walk through the village or area to broadly ascertain from visual observation;

- General environmental conditions in the area
- Access to resources and infrastructure and
- Vulnerability of the people.

The household visits also provide an opportunity to conduct the baseline interviews (mentioned above) and ascertain circumstances at household level.

In addition, these household visits are set up to showcase practices and local innovations that participants are already undertaking. The 'walkabouts' are informal and conversations are recorded for later summaries and photographs are taken to record the conditions in the area and the practices.

5.3.3.1 Example of a walkabout with household visits in Sekororo, Limpopo (2017)

Summary of discussions around CRA practices from a group of 9 participants visiting 4-5 households scattered across the village:

Practices we are already familiar with: Mulching trench beds, furrows and ridges, intercropping, planting herbs, diversification (or different kinds of crops planted together), small dams, compost.

Further comments made by the group include:

- Mulching is done, but is not so popular, because of lack of materials
- Earth dams are dangerous for children
- Rainwater harvesting tanks are expensive – we are using drip irrigation (2nd hand from commercial farms)
- Hybrid seeds are expensive and problematic as seed cannot be kept, even though they have given very positive results.

Practices gleaned from community walkabout: Small earth dams, planting grass in eroded areas, planting and keeping seed of old and traditional crops such as shallots, cowpeas, as well as indigenous greens such as cleome, using kitchen scraps in shallow trenches, compost pits, banana circles, management of mango trees by some pruning, planting green beans under shade of trees rather than sugar beans as the latter does not pod well in the shade., protecting litchis from birds using netting. Participants learnt about pollination processes for mangoes. They did not know about male and female flowers. They also commented that 'normally when we see brown patches on the mango leaves, we did not think that this can affect the fruiting'. With the age of the trees, quality and quantity of fruit deteriorates.

Above Left to right: Local innovations
1 small dam 2 shallots grown and seed kept 3 banana circles with compost 4 furrows and ridges

5.3.4 Example of a CCA workshop1 process

A number of workshops were held across three provinces in 7 villages, working with around 200 participants in total and the results have been summarised to provide a 'snapshot' of climate change impacts for these three provinces

Table 2: Summary of climate change impacts from CCA workshop 1, across three provinces (2017-2018)

Climate change impacts on livelihoods and farming			
	KZN	**EC**	**Limpopo**
Water	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain	Less water in the landscape; streams and springs dry up, borehole run dry, soils dry out quickly after rain
	Dams dry up	Dams dry up	Dams dry up
	Municipal water supply becoming more unreliable	Municipal water supply becoming more unreliable	Municipal water supply becoming more unreliable;
			Need to buy water for household use – now sometimes for more than 6 months of the year
			RWH storage only enough for household use.
Soil	More erosion	More erosion	More erosion
	Soils becoming more compacted and infertile	Soils becoming more compacted and infertile	Soils becoming more compacted and infertile
			Soils too hot to sustain plant growth
Cropping	Timing for planting has changed – later	Timing for planting has changed – later	Can no longer plant dryland maize
			All cropping now requires irrigation – even crops such as sweet potato
			Drought tolerant crops such as sorghum and millet grow – but severe bird damage
	Heat damage to crops	Heat damage to crops	Heat damage to crops
	Reduced germination and growth	Reduced germination and growth	Reduced germination and growth
	Seeding of legumes becoming unreliable	Seeding of legumes becoming unreliable	Seeding of legumes becoming unreliable
	Lower yields	Lower yields	Lower yields
			Winter vegetables don't do well – stress induced bolting and lack of growth
	More pests and diseases	More pests and diseases	More pests and diseases
	Loss of indigenous seed stocks		Loss of indigenous seed stocks
Livestock	Less grazing; not enough to see cattle through winter	Less grazing, not enough to see cattle through winter	Less grazing; not enough to see cattle through winter
	More disease in cattle and heat stress symptoms	More disease in cattle and heat stress symptoms	More disease in cattle and heat stress symptoms
	Fewer calves	Fewer calves	Fewer calves
	More deaths	More deaths	More deaths
Natural resources	Fewer trees; too much cutting for firewood	Fewer trees, too much cutting for firewood	Fewer trees; too much cutting for firewood
	Decrease in wild animals and indigenous plants	Decrease in wild animals and indigenous plants	Decrease in wild animals and indigenous plants
	Increased crop damage from wild animals such as birds and monkeys	Increased crop damage from wild animals such as birds and monkeys	Increased crop damage from wild animals such as birds and monkeys
	Availability of indigenous vegetables has decreased		No longer able to harvest any resources due to scarcity
			Increased population puts pressure on resources
Social	More diseases	More diseases	More diseases

Climate change impacts on livelihoods and farming			
	KZN	**EC**	**Limpopo**
	Increased poverty and hunger	Increased poverty and hunger	Increased poverty and hunger
	Increased crime and reduced job opportunities	Increased crime and reduced job opportunities	Increased crime and reduced job opportunities
			Increased food prices
			Increased conflict
			Inability to survive

Although many of the impacts are similar across the three provinces, the severity of these changes is a lot more obvious in Limpopo; where comments like "we will all die", "we will need to move from here to the cities" and "it feels like the end of the world is coming" were not uncommon.

In all the provinces, but more so in KZN and Limpopo people felt that they are being punished by God for the disintegration of their social fabric. They mentioned that people no longer follow the old rules or keep to their traditional beliefs and taboos, people do not care properly for their families and immorality, violence and theft are all too common. There is thus a tacit understanding that these social problems exacerbate their ability to survive well into the future.

Potential adaptive measures were discussed as an outcome of the impact mind map and participants discussed in small groups possible practices and ideas which could help them adapt to the changes and reduce the negative impacts of these changes.

Being practically minded, most of the participants moved straight from impacts to practices – so strategies were not really discussed. Some of the groups had many ideas, some of which were gleaned from working with support organisations and NGOs. Those groups where no external support is available, did not have many 'new" ideas, but focussed more on doing what they are currently doing better.

Below is an example of this discussion for Turkey in Limpopo (with limited external support)

Table 3: An example of potential adaptive measures from the Turkey (Limpopo) climate change dialogue process (2018)

Turkey CC workshop; December 2017			
Impacts	**Description and linkages**	**Outcomes**	**Potential adaptive measure**
GROUP 1			
Reduced water availability	Dams dry out, boreholes provide less water, rivers dry out, less rain	Reduced production, hunger, diseases, no jobs, poverty, crime, death	More boreholes, more dams, water management, irrigation in evenings and early morning, mulching, trench beds (keep moisture in and soil cool)
Drying of environment	Soils are hotter and drier, drought, plants wilt, increased pests		Save plant residues for animals, buy fodder, control pests on animals
Reduction of resources	Deforestation, fruit trees die, livestock, wild animals die		Planting of trees after they have been cut down, make use of paraffin stoves and electricity, government involvement in solving the problem,
GROUP 2			
Extreme heat	Early fruiting, trees wilt	Poor crop health	Shade netting
Shortage of water	Rivers dry out, municipal supply only once per week. Boreholes dry out	Lack of education towards saving water	NGOs and government to assist trench beds, mulching, save water in dams, drip irrigation, irrigate in evening, boreholes, greywater
Reduction of resources	Less grazing, seed shortage, trees are removed, indigenous animals are no longer there		Donations for/of seed Rather use paraffin stoves than firewood. Only chop down mature trees to allow others to grow, planting trees, government intervention Taking care of indigenous plants

Turkey CC workshop; December 2017			
Impacts	**Description and linkages**	**Outcomes**	**Potential adaptive measure**
			Plant fodder for livestock
Soils	Poor cultivation practices, soil erosion, dry soils, sandy soils		Using crop residues and manure
Social repercussions	Less or no food, health problems, no jobs	Burning of buses, divorce, separation of families, poverty, crime	Getting access to health care, parents must work
Shortage of implements			Setting up cooperatives for government support, use animal drawn traction – oxen and donkeys, improvise, make our own tools, make use of hand hoes

When this table is compared to a community who have been involved in a support programme, such a Sekororo where Lima RDF have been running a Food security and livelihoods improvement programme, the differences in suggestions clearly indicate some ideas gleaned from the facilitating organisation

Table 4: An example of potential adaptive measures from the Sekororo (Limpopo) climate change dialogue process

Sekororo; CC workshop November 2017			
Impacts	**Description and linkages**	**Outcomes**	**Potential adaptive measure**
GROUP 1			
Heat	Plants wilt and die	Lack of grazing, livestock ide	Mulching, controlled grazing, reduce stock, save/store fodder – leaves and grasses for dry season
Water shortages	Rivers drying out, boreholes drying out		Greywater, purification using moringa seeds, water storage for dry season
Soil	Soil erosion (more dongas), soil fertility decreasing,	Deterioration of roads – making access difficult	Planting in tyres, keyhole beds, tower gardens,
Crop production, resources	Lower yields, more pests, veld fires, reduction of indigenous trees Common pests: cutworms, millipedes, centipedes		Natural pest and disease control, mulching (but this can increase some pests), inter cropping, crop rotation, use of multi-purpose plants (e.g. marigolds) Use the wild cucumber (yellow inside) dry, grind and spray on crops to control nematodes and soil pests Manage cutting of trees and plant more Plant in tunnels
Livestock	Lack of grazing, more diseases, more damage of crops	Livestock decreasing, not healthy	Control grazing,
Social repercussions	Poverty, diseases, hunger	Crime, murder and theft, domestic violence, divorce, increased death rate, no money to pay lobola	
GROUP 2			
Extreme heat	Veld fires		Use of tunnels, plant heat resistant cultivars, irrigate in early mornings and evenings
Lack of water	No grazing, drying of natural vegetation and bushes, wilting of plants, trees do not fruit, extreme rains destroy infrastructure,	Food shortages, animals die due to lack of grazing,	Water harvesting, earth dams, grey water and management of existing water, diversion furrows

Sekororo; CC workshop November 2017			
Impacts	**Description and linkages**	**Outcomes**	**Potential adaptive measure**
Soils	Organic matter content is low, dry soils, roots are exposed, soil erosion, also due to use of mechanisation – ploughing		Liquid manure, make use of animal manure, trench beds and eco-circles Plant sweet potatoes to hold soil, plant across the slope, plant indigenous crops such as cowpeas, Make use of hands and oxen to plant using conservation agriculture Loosen the soil to avoid water logging and yellowing of plants
Crops	Reduced production increased pests, medicinal herbs destroyed in drought and heat		Plant colourful flowers and plants to attract pest predators and bees, companion planting, making brews form marigolds Plant medicinal species in controlled environments with the vegetables 9tunnels)
Social repercussions	More diseases and health problems, poverty food shortages, low education standards (because schools are free)	No transfer of knowledge, crime	Plant herbs and vegetables, entrepreneurship, job creation, plant your own crops instead of always buying

5.3.5 Prioritisation of Adaptive measures and practices

Based on the adaptive measures suggested a selection of the CRA practices summarised as 1-pagers are introduced to each group. This process is easy for groups that have had some exposure to agroecological practices and support in implementation and a lot harder where little outside support has been available.

5.3.5.1 Database of CRA practices

This database can be found as a separate document on the DSS website entitled “CRA practices” and consists of 44 practices under 4 headings (soil management, water management, crop management and livestock integration) and have all been tried out and assessed for resilience impact under smallholder farming conditions.

In any situational analysis, the local smallholders are likely also to have their own ideas and specific requests that should be added to the list of potential practices. These could include for example requests for cropping calendars, specific crop types to try out and even practices such as biodigesters or rainwater harvesting tanks.

5.3.5.2 Criteria for selection of practices

Once an initial rough list of potential practices has been put together, participants spend some time thinking through criteria they would use to prioritize implementation, based on the question “How would you decide which of these practices to try out and use?

A few examples of such criteria are shown in the following small list:

- Availability of material
- Increased water infiltration and water holding capacity (water use efficiency)
- Increased availability of water
- Costs – cost efficiency, cost-benefit
- Labour (labour vs benefit)
- Crop quality (germination, growth) and
- Fewer pests.

These criteria are then used to start a matrix ranking exercise. The criteria are placed along the top row of the matrix and the practices are placed in the first column. Then a scale is decided upon with the group. The scale can for example be from 1 to 3; where 1 means little or “bad” and 3 means lots or

"good". Each practice is related to each criterion and given a score. For example, tower garden is related to availability and then given a score, then eco-circles are related to availability of materials and so on.

An aspect to keep in mind when facilitating matrix ranking exercises, is that they work best in small groups of up to 10 participants. If the group is large, participants should be divided into small groups to undertake this exercise.
Below is an example of such a matrix ranking exercise

Table 5: Matrix ranking exercise for an initial prioritization of adaptive or CRA practices to try out (Ntabamhlophe, KZN, 2018)

Practice	Availability of materials	Water use efficiency	Increased water	Cost	Labour	Crop quality	Fewer pests	Score
Tower garden	2	3	1	2	3	3	3	17
Eco circle	3	3	1	3	2	3	3	18
Underground tanks	1	3	3	1	1	3	3	15
Trench bed	3	3	1	3	1	3	3	17
Mulching	2	3	1	3	3	3	2	17
Lizard hotel	3	1	2	3	2	3	3	17
Diversion furrow	3	3	1	3	1	3	2	16

NOTE: Categories such as cost and labour should be carefully considered – as one may be tempted to give a rating of 3 for high cost – except that lower cost is "good" in this instance and thus low cost=3 and low labour=3

Comments on the matrix from group participants:

- Eco-circles are the practice that most participants have tried
- Underground tanks are not really done as they are expensive and difficult to do. They do however have a huge potential to make a significant difference
- Savings groups could be a way to help with the issue of money
- The matrix is a very useful method for decision making
- It is good to do a number of different things and
- The more knowledgeable participants will help the others to try these practices.

This initial prioritization is kept by the facilitators, so that it can be used to re-introduce the discussion for CCA workshop 2. The second workshop is often held some weeks after the first one and thus participants need a 'refresher' in terms of what was discussed already.

5.4 CCA WORKSHOP 2: PRIORITIZATION OF ADAPTATION STRATEGIES AND PRACTICES

The aim of this workshop is to find an appropriate basket of practices for the participants to "pilot" or try out as experiments, to assess their value. The idea is to find practices that participants have immediate energy and motivation to experiment with and also to build on practices to attempt to address some of the large, more recalcitrant problems in the area; such as lack of water and erosion.

The workshop consists of two broad activities:

1. Prioritization of practices: Matrix using farmer level criteria for assessment *(matrix ranking and scoring)*
2. Planning of farmer experimentation, learning sessions and implementation of practices (*Individual experimentation outlines, lists)*

5.4.1 Outline of CCA workshop 2

Community level climate change adaptation: Prioritisation and planning workshop outline					
DAY 1					
Time	**Activity**	**Process**	**Notes**	**Materials**	**Who**
9:00am	**Introduction**				
9:00-10:00am	Community and team introductions	In pairs, take 5 minutes to talk to each other. Each person names one practice they know or are doing that is good for CCA – a CRA practice. OR one they would most like to try out.	Practices to be summarised on a flip chart.	**Attendance register** – with column for CRA practices – in English and Zulu/Pedi. **Name tags;** stickers, kokis	**Preparation: Facilitation: Recording:**
	SAEON weather predictions	Presentation and group discussion on the SAEON weather prediction maps that are produced quarterly to ascertain usefulness to farmers as a decision-making tool	Copies of the temperature and rainfall maps produced for each small group		**Preparation: Facilitation: Recording:**
	Purpose of the day	Introduction of the organisation/s and purpose of this workshop – Review of understanding of CC, Impacts and adaptive measures. Introduction to CRA principles	Summarise from report of 1st workshop – Use the 5 categories – summarise measures under each. Use two PP slides attached	Flip stand, newsprint, kokis, camera – and one person to undertake to take **photos** throughout the day. Extra batteries for camera and sim card	**Preparation: Facilitation: Recording:**
10:00am	**Prioritization of practices**				
10:00 to 11:00am	Review practices mentioned in detail – both community level and presented from 1pgers	Divide into small groups – for prioritization matrix; Use five categories (Nat res, soil, water, crop, livestock). Supply with cards where all prioritized practises are written. They then prioritize these in a list under each category, based on what to try first, second and so on – make sure the criteria used for these choices are recorded. Come back in plenary, present and get overall choices summarised for all small groups	See Community level prioritization of practices Excel worksheet	Flipchart paper, kokis, cards with all prioritized practices written out, prestik	**Preparation: Facilitation: Recording:**
11:00-11:30am	**TEA**	Fruit (apples, oranges, biscuits, juice and water, paper cups (lots) and plates… Generous helpings – and lots of juice if it is hot. Find someone to be in charge of food and refreshments, while the rest of the workshop continues			**Preparation:**
11:30	**Demonstrations and learning**				

Community level climate change adaptation: Prioritisation and planning workshop outline				
DAY 1				
11:30-2:30pm	Learning and practical demonstration session on a selection of practices – start with gardening practices (appropriate for present season)	Presentation to group – discussions, etc., then practical demonstrations in an appropriate garden – preferable a household garden. Choose 1-4 practices: e.g. trench bed, mulching, liquid manure, intercropping	Facilitators to come prepared with handouts and learning materials. Also, materials for doing the practical demonstrations such as mulch, manure, seed, seedlings, tools, and other, e.g. shade netting, poles, gravel and ash for tower gardens – depends on practices and must be planned for	**Preparation:** **Facilitation:** **Recording:**
2:30pm	**Individual experimentation**			
2:30-3:00pm	Individual choice of practices for household experimentation	After the demonstrations – Make a list for individuals to choose experiments to try out. Headings are practises. Each participant writes their name under the practices they will try – it can be one, a few or all.	Facilitators to discuss how an experiment works – i.e. the farmer compares the new idea to her usual practice. For example, if she will do a trench bed, she has to make a bed new to it the same size the way she usually does and plant both in the same way on the same day. This way she will be able to see the differences in growth and yield from her practice. She needs to monitor how it is going and be able to report back to this group what has happened.	**Preparation:** **Facilitation:** **Recording:**
	Input on farmer level experimentation	Group based input to discuss aspects of experimentation; choosing an experiment, what to monitor, observe and measure	Copies are made of the farmer level experimentation form and individual farmers work together in small groups to outline their experiments	**Preparation:** **Facilitation:** **Recording:**
3:00pm	**LUNCH** Local catering groups to provide meals – ~R45 per head (Rice and stew with one veg… or something similar)			**Preparation:**

5.4.2 Example of CCA workshop 2

This is a summary of a workshop that was held in Ezibomvini village, close to Bergville in KZN, in 2018.

CCA practices that are familiar to farmers

An introduction session over five minutes took place where farmers were to introduce each other and their farming activities. Following is the summary of the results from the discussions:

- The use drip irrigation to retain moisture for a long time in the soil.
- Grey water harvesting practice.
- Use of cow manure
- Mulching
- Intercropping
- Bed design
- Rain Water harvesting
- Watering the garden before sunrise and after sunset
- Blue death as pest and disease control measure and
- Conservation Agriculture (CA)
    - CA farmers receive more yields, the level of pests such as stalk borer and cutworm has decreased. Farmers are saving on inputs.

Review of participants understanding of climate change

Farmers still remember the previous discussion on climate change and that the weather patterns have shifted from what has been experienced in the past; the level of rainfall is now lower and temperatures are high. The increase in temperature has a negative impact on crop growth. There are stronger, hotter winds, which dry the soil. Historically it was only windy in winter and presently it is windy throughout the year. There are no wetlands anymore because of reduced rainfall and people building houses where there were wetlands.

The impact of climate change on farmer's livelihoods

- The outbreak of pests and diseases: There is an outbreak of pests such as aphids, termites, and cutworms, which farmers do not know how they can solve this problem. Some farmers have ants in their gardens and they used blue death
- Shortage of animal feed: The high temperatures lead to dry conditions, therefore there less vegetation growing and available for livestock to graze on the grazing lands
- Burning of Grazing veld: Farmers have different reason to burn the veld, some burn it to dispose of the straw left after grazing so that the field can be ready for the following spring, and some burn it for soil fertility and health purposes. At the end of the day burning of veld leads to disease outbreak to livestock. Previously our great grand fathers were creating fire breaks so that fires do not spread all over, in nowadays males are lazy and they do not do that and
- Shortage of grazing lands: The population is increasing all the time; more people are building houses and this has led to the building of houses in the grazing lands.

CRA practices that were suggested by farmers on the previous workshop

The following table outlines the practices and their categories.

Table 6: Suggested practices for farmers, categorised into the 5 primary themes.

Practices	Natural Resource Management	Soil	Water	Crops	Livestock
Tunnels					
Bed design					
Mulching					
Natural pest and disease control					
Rainwater harvesting					
Trench beds					
Composting					
Fodder crops					
Underground water tank					
Mixed cropping					
Conservation of wetlands and streams					
Burying of disposable pampers					
Reducing burning of grazing veld					
Greywater Harvesting					

Group Prioritisation of practices

After the exercise of categorising the initial list of potential CCA practises, the group went on to the matrix ranking exercise, now prioritizing the practices that they specifically would like to try out. Due to the drought conditions in the area, farmers focused on practices that would improve their access to water and also the efficiency of water use in their farming. Due to harsh weather conditions farmers chose tunnels as their second option. The following figure shows how farmers prioritised practices.

Group Priority in order of importance

1. Underground water tanks
2. Tunnels
3. Trench beds
4. Mulching
5. Pest and disease control
6. Mixed cropping
7. Compost
8. Fodder crops
9. Conserving wetlands and streams

Figure 17: group prioritization of a basket of CRA options for Ezibomvini

Individuals then indicate on a list of practices those they would undertake immediately; in this case participants focused on trench beds, mixed cropping and mulching. In this example 20 of the 29 participants present chose to start with trench beds. An input is provided on farmer level experimentation and how farmers can use this process to make observations about the new idea, as compared to their normal practice.

Another example, where the prioritization of practices was done slightly differently is shown below. This is for participants who belong to a learning network Imvoto Bubomi in the Eastern Cape.

Table 7: CRA Practices: Prioritization by groups and individuals

NOTE: Groups in this case are the small groups in the workshop setting consisting of homestead gardeners, cooperative members and more commercial farmers

Practice	Scale at which practice is appropriate: (Small: Homestead, Medium: <1 ha, Large: >1 ha)	No of Groups (out of 4 subgroups)	No of Individuals (for experimentation)
Swales	All	1	3
Greywater	Small	1	
Small Dams	S/M	1	
Fertility Pits	S/M	1	
Contours	M/L	1	
Terraces	ALL	1	
Furrows/Ridges	All	0	1
Infiltration pits/ Banana Circles	Small	1	2
Raised Beds	All	1	
Trench Beds	S/M	1	
Tower Gardens	S	1	3
Tunnel	All	1	2
Basins/In-field	All	1	1
Mulching	All	4	4
Close-spacing, intercropping, mixed Cropping	All – in different ways	3	3
Crop Rotation	All	1	
Minimum Tillage	All	1	
Herbs	All	2	

Liquid Manure	All	2	
Drip irrigation	All	3	5
Underground Storage	S/M	1	
Rainwater Harvesting (general)	All	1	1

What is perhaps most interesting about these outcomes is the great difference between the practices selected by the different groups, with only mulching being identified by all 4 groups, and only the Bucket Drip and the combination close/mixed/inter-cropping practices by 3 out of 4. Essentially almost all the practices listed in the practices 1 pagers document were selected by one or another group.

The individual preferences as recorded in the register were similarly diverse with a similar concentration on (bucket) drip, mulching and close/mixed/inter-cropping. Swales, tower gardens and tunnels were also identified as being of specific interest to several participants. Only one participant identified large-scale furrows and ridges and infield RWH as being of interest to them. Below is the table filled out by a selection of the participants in choosing the practices they would want to experiment with for the upcoming season.

Table 8: Individual farmer led experimentation choices; EC, Aug 2018

Name and Surname	Tunnels	Bucket Drips	Tower Gardens	Trench beds	Furrows and ridges	Grey water	Small Dams	Herbs	Terraces	Fertility pit	Swales or contours
Aviwe Biko	✓	✓				✓			✓	✓	✓
Monwabisi Jende	✓	✓			✓	✓	✓	✓			
Xolisa Dwane	✓	✓	✓		✓		✓	✓			
Thango Hogana			✓	✓							
Phindisiwe Msesiwe	✓	✓									
Siyabulela Hafe							✓	✓			

Learning workshops that can provide theoretical information and practical demonstrations of the practices chosen can then be planned with the participants. Ideally, ongoing monitoring of the farmer level experiments need to be undertaken and a review session held at the end of the season to discuss observations and learnings and plan for the following seasons' experimentation

5.4.3 Seasonal weather predictions

It is considered to be important to have reliable climate information locally available to smallholder farmers. For this process, we accessed easily available information from the South African Weather Services (SAWS); called the 'Seasonal Climate Watch'. The SAWS use long range forecasts and a coupled modelling system to create quarterly predictions for rainfall and temperature for South Africa. (http://www.weathersa.co.za/home/seasonal)

Below are examples of the maps produced. The following maps indicate the rainfall climatology for the early-summer (Dec-Jan-Feb), mid-summer (Jan-Feb-Mar) and the late-summer (Feb-Mar-Apr). The rainfall and temperature climate are representative of the average rainfall and temperature conditions over a long period of time for the relevant 3-month seasons presented here.

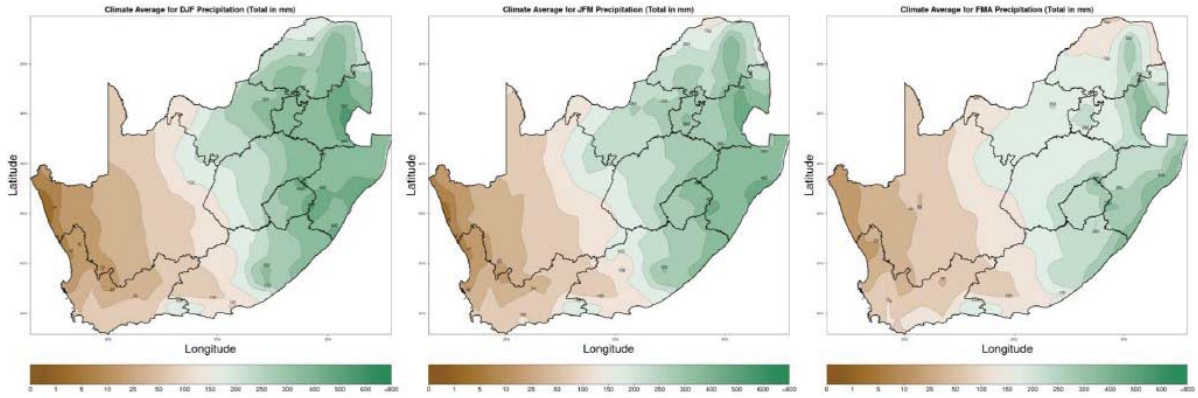


Figure 18: An example of rainfall prediction maps for December 2019-April 2020 (SAWS, November 2019)

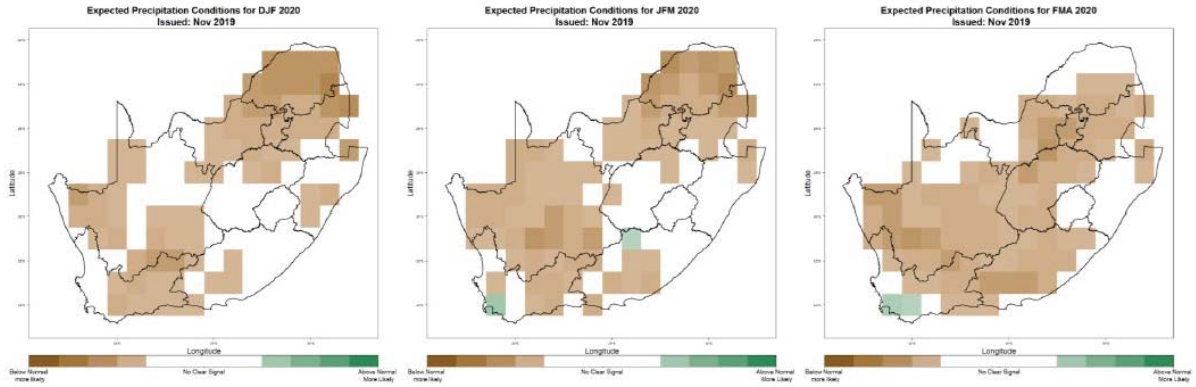


Figure 19: Maps indicating the predictions for higher than normal (green) and lower than normal (brown) average rainfall for December 2019 to April 2020 (SAWS, November 2019). The white areas on these maps indicate rainfall patterns that are similar to the long-term averages.

Sets of maps were reproduced and used in a workshop setting with smallholder farmers, to work together to learn to read and analyse the information from the maps and then to decide how that information could be useful in their agricultural planning.

Smallholder participants in these discussions spoke to needing to know when to plant, their dryland fields, as there is increased uncertainty due to large weather (rainfall and temperature) variability. They wanted to be provided with planting dates, but upon discussion realised that the climate modelling predictions are not a definitive answer, but only a highly probable outcome for the season. They felt that they could not take the risk of planning their cropping season according to these predictions and that in effect such planning was similar to what they are already doing; planting when the rains start and hoping for the best. They did indicate that it was useful to have a sense of what the upcoming season would be like, but that it wasn't much help for them in terms of planning. The maps corroborated their feeling that planting times are later, given the late onset of summer rainfalls.

The smallholder participants liked the idea of being able to have some local indicators, such as rain gauges to help them make decisions, but did not feel confident about relying on information such as the seasonal climate watch forecasts.

5.4.4 Farmer experimentation

Farmer experimentation was introduced explaining that t*he best way to learn is to do it and compare it with whatever you are doing.* Thus, the control becomes the "normal way" and that is compared with the new idea. It is important to try new ideas out on a small scale to reduce risk. Decisions about how to observe and measure the differences are made at the onset of the experiment and these

observations and measurements are recorded throughout the season, so that an informed decision can be made about the potential benefits and challenges of the new idea.

Once an innovation (new idea) has been tried and established, that farmer may begin experimenting with other innovations. At the same time, she/he may teach the innovations already implemented to others. When technology is introduced slowly by overcoming limiting factors one by one, farmers have a chance, not only to test, implement and share the innovations, but also to build up strong circles of knowledge amongst themselves. It also means that the role of the facilitator is not to try and convince farmers to "adopt" specific technologies and innovations but is more to introduce new ideas/innovations that farmers can try out for themselves and make their own decisions.

The following form is filled in by individuals, or groups of individuals in a workshop setting, to assist the farmers to think through the aim, implementation and monitoring of their experiment.

Small Scale experimentation plan

What is the problem?

What is the possible solution?

Why will this solution solve the problem?

How will I test this solution step by step?

What will I look for and what will I measure?

How will I measure the results or outcomes?

How will I compare my experiment to my usual way of farming?

Drawing of the experiment in the field.

Figure 20: Outline of a planning process for farmer level experimentation

6 PARTICIPATORY IMPACT ASSESSMENT (PIA)

6.1 BACKGROUND

A specific framework for monitoring of impact of the CRA practices on livelihoods and vulnerability is required to be able to assess increased resilience. This framework works alongside the entire monitoring and evaluation process; with activity, output and outcome indicators.

For this process the PIA framework has been used to outline the indicators used at community level and provide for a qualitative assessment of increased resilience by community members. A group process has been designed and tested, as has an individual survey instrument. Both will be reported on here.

In PIAs there are three basic questions:

1. What changes have there been in the community since the start of the project/process
2. Which of these changes are attributable to the projects
3. What differences have these changes made to people's lives.

Impact indicators measure changes that occur in people's lives and can be qualitative or quantitative. These indicators look at the end result of project activities on people's lives. Ideally, they measure the fundamental assets, resources and feelings of people affected by the project. Therefore, impact indicators can include household measures of income and expenditure, food consumption, health, security, confidence and hope.

Community impact indicators may be quantitative, such as income earned from crop sales, or qualitative, such as improved skills, knowledge or social status. Tracking changes in food availability, income and expenditure can often be a useful way of measuring impact against community indicators of impact and against coping strategies (Catley, Burns, Abebe, & Suji, 2014)

As impact measures change, there needs to be a starting point, or baseline from which the changes can be assessed. There are different types of indicators in a socio-ecological system. Indicators need to be chosen to be measurable

Below is an example of a set of indicators which have been designed for this research process, which shows the linkage between the vulnerability and impact indicators.

Table 9: Comparison of socio-ecological indicators used for vulnerability and resilience assessments

VULNERABILITY	RESILIENCE
Socio-economic indicators	
Economic: Income (types, amounts), savings (types, amounts), markets (formal/informal)	Economic: Income (types, amounts), savings (types, amounts), markets (formal/informal), access and sales
Social: Gender, household head, social organisations,	Social: social organisations,
Human: education level, access to information	Human: access to information, (sources), knowledge and skills
	Physical: Access to water, electricity, equipment, farming (gardens, fields, livestock)
Access to resources	
Resources and infrastructure: Access to water, electricity, equipment	Resources and infrastructure: Improved access to water, improved access to equipment, equipment
Productivity	
Farming activities: Gardens, fields, livestock, food provisioning	Increased farming activities, continuity, increased productivity, increased food provisioning, increased water use efficiency (RWH, access, availability, efficiency), soil fertility and soil health

The resilience impact monitoring and assessment process designed has two components:

- A focus group based participatory impact assessment process and

- A questionnaire-based individual interview process. These are called Resilience Snapshots, as they are considered a measurement of change at a certain point in time (e.g. seasonally, annually), but are not considered an end-point as adaptation and building adaptive capacity is an ongoing process.

These two processes are outlined below.

6.2 PIA WORKSHOP OUTLINE

These workshops are conducted with smallholder farmer participants who have been involved in farmer level experimentation and implementation of CRA practices for a minimum of two to four seasons; where a season is broadly defined as either winter or summer.

The intention is for the participants themselves to jointly develop the impact indicators that are appropriate for them and then to use these indicators to analyse and assess the changes in their system.

6.2.1 Recap climate change impacts

Explore what people have noticed around climate change impacts and make lists under headings: natural, physical, economic, human and social.
Group level brainstorming of ideas; written on cards under the headings given, with arrows for increase or decrease.

6.2.2 Recap adaptive strategies/ practices

- What have people been doing to adapt to this, fix the problems, make things better?
- What can be done? (first look at what has been done so far and then any further ideas of what can be done)
- Elucidate adaptations for each category: natural, physical, economic human, social

Group level brainstorming: Write on different cards (those done and those thought of) and place next to the impact, indicate with a * which of these have been facilitated or introduced (and by whom) – this can be other farmers, projects, extension officers, etc.

6.2.2.1 The five fingers tool

In addition to monitoring being conducted by facilitators a local framework for self and peer assessment and monitoring of progress is employed using the 'five fingers' principles, as developed by AWARD (http://award.org.za/wp/wp-content/uploads/2020/05/AWARD-BROCHURE-Principles-of-Soil-Water-Conservation-in-Agroecology-2019-v1.pdf). Local criteria for assessment of each 'finger' (things we are doing and changing) are developed alongside an easy scoring progress to track changes and progress.

This tool has been slightly adapted by MDF to accommodate for the five thematic focus areas of the CRA experimentation and implementation process namely:

- Soil management: Adopt practices that limit soil movement and build and maintain soil health
- Water management: Practice good water management to enhance soil moisture and limit water movement
- Crop management: Manage crops for diversity, location and sustainability
- Livestock management: Manage livestock for diversity, location and sustainability
- Natural resource management: Protect and maintain indigenous plants as part of farming practice and
- People working together

The 6th category (the whole hand) has been added in MDF's work to accommodate for the principle of people working together (social agency and collaborative actions).

6.2.3 Practices: Recap five fingers and list all practices under each category

- Re-introduce the 5 fingers concept and include a further category of the whole hand – which is the social and personal
- Which practices have been implemented (introduced and other)? Go around in the circle and each person mentions what s/he has done (productive, economic, social, personal actions) and what she would still like to try
- Add these practices to the five fingers diagram. Make an A1 diagram of the five fingers and then add practices on cards
- Go through practices recommended through the DSS. Use cards with ranked practices from the DSS – describe and show the ones that people are not familiar with.
- Rank practices for next round of implementation. Rank the list of practices by a show of hands.

6.2.4 What have been the changes or benefits from each practice?

- What changes have there been? Brainstorm changes and interrogate answers to get to the more
- How important are these changes to your lives? How do you decide? Which criteria would you use to decide?
  Do a matrix ranking: Changes (in columns), criteria (in rows) – Use proportional piling, working down each column by asking "how important is this practice for the criteria" and comparing the practices with each other (to an extent) as you go down the list. The exercise is done in small groups of 5-8 participants

Below is an example of what the matrix could look like.

	Food	Income	Soil, water	Access, ease of implementation	knowledge
Trench beds					
Tunnels					
CA					
Cover crops					
Legumes					
Other crops; potatoes, sweet potatoes					
Savings					
Subsidised inputs					
Saving for inputs					
Farmer centre					
Small businesses					
Learning group					
Water committee					

6.2.5 Expanding on practices

- Introduce new practices for each of the 'five fingers'
- Participants assess each practice (after deciding on criteria for how you decide this practice is useful)

Eventually the whole exercise can be summarised in the matrix below.

	Natural	Physical	Economic	Human	Social
CC impacts					
Adaptive strategies					
Actions/ practices					
Changes due to practices					
Importance of these changes to your livelihood					

6.2.6 Example of a PIA assessment outcome: Bergville KZN (2019)

Below a few of the outcomes of a PIA process conducted for a CRA learning group consisting of participants from 5 different villages is summarised as an example.

6.2.6.1 Participatory assessment of climate change impact

Table 10: Climate change Impact assessed according to livelihoods indicators (Bergville, April 2019)

Natural (environment and farming	**Physical (infrastructure, environment)**	**Economic**	**Human (Skills, knowledge, agency)**	**Social (organisation, cohesion)**
Earthworms disappear	Water shortages; reduced flow in streams and springs, boreholes dry up	Food shortages	Increase in diseases in humans	No progress here
Degradation of veld and reduced grazing	Severe erosion of roads and damage to houses by heavy rainfall	Water shortages at household level	Farming is done by older people; the younger people are lazy	People don't work together
Livestock break into fields and eat crops	Dongas are increasing in number and size	Farming inputs and services are very expensive	Water borne diseases from drinking dirty water	Traditional leadership is no longer respected
More diseases in cattle, requiring purchase of medication and vaccines and more deaths	Damage to wetlands from people building there, overgrazing and other uses.			Other community members steal farmers' produce
Contours in the fields, that were made many years ago have not been maintained causing erosion in the fields	Severe erosion due to denuding of land, followed by heavy rainfall			Learning groups; some conflict in some of the learning groups has reduced participation.
More crop damage from birds than before Dry soil Seeds don't germinate Extreme winds that damage vegetation and crops More veld fires More pests in crops and new pests that were not present in the past Fertilizer is ineffective in hot, dry conditions Planting times for crops are changing in unpredictable ways There are small water sources in some people's homesteads, which they refuse to share with others	SOME GENERAL ADAPTIVE MEASURES PROPOSED - Savings - Rotational group saving for buying and putting up fencing - Small businesses - Buying fencing - Request support for fencing and ask Government support as well – although with the latter participants are aware that Government support is unlikely. COMMENTS ON PLANTING DATES - People who planted in November – have struggled with lack of germination - More germination for those who planted in December - Spraying with Decis (pesticide against cutworms and stalk borer) helped with germination and growth (more pests were present) and reduced eating of seed by birds - A few participants even planted in January – and this worked quite well in this last season - One participant in Thamela mulched her whole field and planted in November and has had promising germination and growth from this - Participants also noted that beans did not grow at all, but the cowpeas have done reasonably well, even under these difficult conditions. It is difficult to make decisions about planting dates now that the climate is more unpredictable. The importance of crop residues to maintain soil moisture cannot be under-estimated			

6.2.6.2 Participatory assessment of Climate resilient Agriculture Practices

Participants described CRA practices they are using under the five fingers (soil, water, cropping (gardening and field cropping, livestock and natural resource management. We decided also to include a further category – social agency, or what they described as people management

Table 11: CRA practices implemented in the Bergville area 2017-2019

Soil	Water	Crop (garden and field)	Livestock	Natural Resources	People
Making compost	Drip irrigation	Diversified crops in gardens; beetroot, Chinese cabbage, carrots, parsley, thyme,	Vaccinations		Savings
Use of goat and cattle manure	Mulching	Shade cloth tunnels	Dipping		Small businesses
Canopy cover and legumes (Lab-Lab)	Infiltration pits	Beds: raised beds, trench beds, eco-circles	Proper feed; including from fodder produced		Farmer centres
Diversified crops to hold soil and prevent erosion	Garden layout with shallow furrows for water harvesting and retention	Tower gardens – fertility and greywater management	Addition of supplements		Selling chickens
	Greywater management	Conservation agriculture; including management of residues	Limiting burning of veld		
	Improved irrigation practices	Inter cropping and crop rotation	Planting grass: ungwengwe and kikuyu		
	Rainwater storage in JoJo tanks and drums	Diversified crops in fields; different varieties of maize, sorghum, millet, legumes (e.g. cowpeas, beans, Lab-lab), cover crops			
	Spring protection	Use of Decis Forte, (Pyrethrins) for pest control in fields			
	Buying JoJo tanks – and negotiating with water trucks to fill these	Liquid manure			
		Mixed cropping in gardens			

6.2.6.3 Participatory assessment of Changes and benefits from CRA practices

This exercise consisted of doing a matrix ranking of practices farmers have used in the past year; incorporating gardening, field cropping, livestock management, soil and water conservation and water issues (access, availability). Impact indicators for this exercise were developed in 2 small groups by asking participants to outline how they make decisions about which practices to use and what changes they would observe.

Below is a summary of the Matrix for each of the 2 small groups. A process of proportional piling was used for the scoring of each practice and indicator – where 100 counters were provided for each indicator and the small group decided how these would be placed proportionally for each practice. In this way participants can comment on; more or less, and how much more or less. The outcome of the exercise is quantifiable in terms of gauging percentages.

For this matrix the practices were conflated to encompass all specific practices within that category:

- Conservation agriculture; minimal tillage, soil cover, crop diversification
- Savings: Village saving and loan associations, rotational saving in small groups towards specific infrastructural needs, personal savings
- Livestock; fodder production, vaccinations, dipping, supplementation
- Gardening; bed design (trench beds, eco-circles, raised beds, tower gardens, tunnels, mulching, mixed cropping, crop diversification, inclusion of herbs, infiltration pits and water conservation furrows
- Crop rotation; 3-4 crop rotations in field cropping
- Intercropping: grain-legume and grain-cover crop intercropping options in field cropping and
- Small businesses; including agricultural and non-agricultural businesses; sale of snacks in schools, sewing, baking, poultry production, maize milling, etc.

The impact indicators developed by this group are of particular interest as they are multi-dimensional talking at least two different aspects for each indicator. Additionally, the exercise was run so that each practice is compared with the other practices when considering one of the indicators or criteria. This greatly increases the value and reliability of the scores provided by the group.

	Soil; health and fertility	Money; income and savings	Productivity; acceptance of practice, saving in farming – equipment, labour	Knowledge; increased knowledge and ability to use	Food; how much produced and how healthy	Water; use and access	Social agency; Support, empowerment	Total
Conservation Agriculture	22	21	26	28	18	23	18	156
Savings	6	15	14	15	12	11	15	88
Livestock	19	11	18	7	5	12	11	83
Gardening	14	15	12	13	15	17	21	107
Crop rotation	16	12	13	12	12	15	10	90
Intercropping	12	13	15	12	11	11	9	83
Small businesses	11	17	15	10	20	11	9	93

The overall impact on livelihoods (which is seen as the combination of the indicators chosen by the group) is shown under the 'total" column. From this, the participants clearly consider the Conservation Agriculture (CA) process as the most significant, followed by gardening, small businesses, savings and livestock – in decreasing order.

6.3 RESILIENCE SNAPSHOTS

The resilience snapshots are individual questionnaires that provide an in-depth assessment of the impact of the implementation of CRA practices on a person's livelihood. Proxy indicators for resilience are built up from the interview.

Below is an outline of the questionnaire

6.3.1 The individual climate change resilience questionnaire

RESILIENCE SNAPSHOT							
Date							
Province							
Village							
Increased farming (Size)		**Before (Size in sqm)**	**Now (Size in sqm)**	**Comment: Percentage increase**			
	Gardening						
	Field cropping						
	Livestock						
	Trees, natural resources						
Increased diversity in farming		**Y/N before**	**Y/N now**	**Comment:**			
	Gardening						
	Field cropping						

	Livestock						
	Trees, natural resources						
Increased diversity (1)		**Management and practices before**	**No b4**	**No now**	**What has changed; new crops**	**What has changed; new practices**	**What has changed; , new management**
	Gardening						
	Field cropping						
	Livestock						
	Trees, natural resources						
		Types	**BEFORE: Quantity (Kg, No)**		**NOW: Quantity (Kg, No)**	**Percentage increase**	
Increased productivity	Gardening						(Amount in kgs/tonnes, 10,20,50 kg bags/containers, no of meals (for a family)
	Field cropping						
	Livestock						
	Trees, natural resources						

	Increase Access	**Inc RWH**	**Inc water holding**	**Inc water productivity (irrigation)**	**SCALE**
Increased water use efficiency (including RWH, water holding, water access, water productivity)					0= same or worse than before; 1= somewhat better than before, 2= much better than before

Increased livelihood security (income)	Income before (Ave monthly in Rands)	Income now (Ave monthly in Rands)	Comments

Increased livelihood security (Household provisioning and food security)	Food types (staples, veg, livestock, fruit)	Quantity/ week (kg)	No of times/ week (1-7)	Sales/week (in Rands)	Comments

Increased livelihood diversity/options	Income options Before	Income options Now	Comment; name new options, e.g. which crops, etc.	Scale
				1=social grants; 2= remittances; 3=farming income;4= small business

	Amount per month Before	Amount per month Now	Use of savings	Scale
Savings (safety, security, achievement)				1=food; 2=household use; 3=education; 4= production; 5=other

Increased growing season		Yes/no Before	Yes/no Now	Comment
	Gardening			
	Field cropping			
	Livestock			
	Trees, natural resources			

Collaborative actions/social agency	Activities in groups Before – name	Activities in groups Now	E.g. savings, church, learning groups, coops, farmers associations, work teams, selling, inputs, farmers centres water committees …

Informed decision making	Information used to choose activities before	Information used to choose activities now	E.g. other community members, learning in groups, written info, radio, facilitators, extension officers, etc.

Positive mindsets	Rate your mindset Before	Rate your mindset now	SCALE: 0=less positive about the future, 1=the same, 2=more positive about the future, 3=much more positive

6.3.2 Example of a resilience snapshot assessment for 12 participants in Bergville, KZN April 2019

Here the individual resilience assessments for 12 participants have been combined and summarised. Summaries of the responses to specific questions are summarised in bullet points and tables.

6.3.2.1 Learning and change

What have you learnt about dealing with CC and climatic extremes?

- I have learnt that practices such as trench beds and CA provide good growth and yields, despite difficult weather conditions. Also, these practices are cheap. We get more food than we did before and will now be able to continue farming
- Adaptive practices like mulching help to deal with increased heat and water stress
- Practices such as trench beds, eco-circles, mulching and mixed cropping enables the soil to hold moisture for longer and withstand the heat and dry spells.

What is your experience regarding the impact of CC on your life?

- This season we had drought; the beans did not grow and maize is stunted. I fear we will not have enough food
- Cattle have been negatively impacted – more disease and deaths as grazing diminishes
- The climate is changing: Low rainfall during the planting season and high temperatures are affecting farming activities
- I have not experienced climate change – I do not have water issues (participant in Midlands of KZN)
- Climate change has destabilised our planting patterns and has created a lot of uncertainty about planting dates for both summer and winter crops

Do you share your knowledge and experiences with the learning group or community members?

- Yes, I talk to my neighbours about the gardening practices, so that they can also try and revive their gardens
- Yes, I have talked to neighbours, some come and visit to see the garden and experiments and some have even taken pictures.
- Yes, I talk to my neighbours and friends and invite them to the learning group sessions if they are not members yet.

How do you share the knowledge gained with other members of your community?

- Discussions at savings meetings, at the springs when we collect water
- When people visit, I show them my garden

What helps you to learn more about new innovations and information?

	No (N=6)	Comments
Listening to other farmers experiences and experiments	6	I get motivated by other farmers' work, get new ideas such as planting potatoes in bags
By doing and experimenting in own garden	4	This helps me to know how good the practices are. have tried a no of experiments and included my own ideas
Motivated by other farmers work and experiences	5	Learnt about raised beds in Msinga
Learning workshops	5	I find them useful because I always hear new information and experiences from the facilitator and farmers

What new things have you added into your practices? How has it worked?

- I have not tried anything else new, outside of the practices we were taught: CA, trench beds, mulching, mixed cropping, RWH, greywater management, seedling production
- I have tried a u-shaped garden which helps to collect water, helping plants to grow better.
- I have used some of the maize and sunflower seed I grew in the CA trials to feed my indigenous chickens; this has helped for a better survival rate and even the ability to sell a few.

6.3.2.2 Climate resilient practices

Impacts and lessons learnt

	Past issues	Past Practice	Present Practice	Impact and lessons
Livestock	Low production	Bartered indigenous chickens	Selling indigenous chickens locally	
	Feed too expensive to buy	Fed chickens' scraps	Feed of sunflower and crushed maize seed from own production	More chickens survive and grow well making sales possible
Gardening	Low yield and dry beds	Raised beds	Trench beds and raised beds	Better growth and yield, increased water holding, beds remain moist during hot periods, beds hold water for a long time, fewer pests and diseases,
		Fetched water from communal taps and springs	Also, RWH and grey water use (unfiltered)	Saves water and time in fetching water to irrigate
			Mulch (dry grass)	Mulch retains moisture, but can encourage termites
		Buy seedlings	Seedling production	Increased number and types of crops;
		Standard veggies	New veggies and herbs	There is demand in the village for the new crops; kale, Chinese cabbage, carrots, More and different food for longer periods in the year
		Short season for planting, or no planting due to lack of water	Winter planting	Grow crops in garden and in the fields (sweet potatoes, potatoes)
Field cropping			CA	Increased water holding and less run-off, increased ability to withstand drought
			Intercropping	Increased availability of more types of food,
			Legumes	Increased yields
			Cover crops	Increased soil health, Feed availability for livestock

Assessment of impact for CRA practices tried out using local indicators

Note: Scoring: -1 = worse than normal practice; 0 = no change; 1 = some positive change; 2 = medium positive change; 3 = highly positive change

	Name of practice	Soil	Water	Productivity	Labour	Pest and disease control	Cost and maintenance	Livelihoods	Adaptation
1	Trench beds	2	2	3	-1	2	0	2	3
2	RWH	0	3	1	-1	0	-1	1	3
3	Mulching	2	2	3	0	3	0	1	2
4	Tower garden	2	3	3	2	0	0	2	2
5	Planting basins	0	2	2	0	0	1	1	1
6	Raised beds, with mulch	1	2	2	1	0	1	0	1
7	eco-circle	2	3	2	-1	1	0	1	1
8	CA; w intercropping, legumes, cover crops	3	2	3	1	1	0	2	2
9	Using goat manure (composted in a kraal)	3	1	2	0	1	0	1	1

Resilience snapshot

This table is a summary of the overall questionnaire (in this case for 12 participants combined).

Resilience indicators	Rating for increase	Comment
Increase in size of farming activities	Gardening – 18% Field cropping – 63% Livestock – 31%	Cropping areas measured, no of livestock assessed
Increased farming activities	No	Most participants involved in gardening, field cropping and livestock management
Increased season	Yes	For field cropping and gardening – autumn and winter options
Increased crop diversity	Crops: 12 new crops Practices: 8 new practices	Management options include; drip irrigation, tunnels, no-till planters, JoJo tanks, RWH drums,
Increased productivity	Gardening – 72% Field cropping – 79% Livestock – 25%	Based on increase in yields
Increased water use efficiency	25%	Access, RWH, water holding capacity and irrigation efficiency rated
Increased income	13%	Based on average monthly incomes
Increased household food provisioning	Maize – 20 kg/week Vegetables – 7 kg/week	Food produced and consumed in the household
Increased savings	R150.00/month	Average of savings now undertaken
Increased social agency (collaborative actions)	2	Villages savings and loan associations and learning groups
Increased informed decision making	5	Own experience, local facilitators, other farmers, facilitators, extension officers
Positive mindsets	2-3	More to much more positive about the future: Much improved household food security and food availability

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