A smallholder farmer level decision support system for climate resilient farming practices improves community level resilience to climate change. No 1: Community climate change adaptation process design

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Summary

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 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.

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. 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 agro-ecology, water and soil conservation, water harvesting, conservation agriculture and rangeland management a measurable impact on livelihoods and increased productivity can be made.

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.

Mahlathini Development Foundation and our partners and collaborators (Universities, NGOs, CSI initiatives, District and Local Municipalities and Government Departments), have been working within the socio-ecological and social learning space to assist smallholder farmers in KZN, Limpopo and the Eastern Cape to improve their resilience and adaptive capacity to climate change by designing and testing a participatory smallholder level decision support system for implementing climate resilient agricultural practices.

Within this process smallholder farmers explore and analyse their understanding of climate change and the impacts of these changes on their livelihoods and agricultural systems. They explore adaptive strategies and measures (local and external), prioritize appropriate practices for individual and group experimentation and implementation, assess the impact of these new practices and processes on their livelihoods and re-plan their actions and interventions on a cyclical basis.

This allows them to make incremental changes over time in soil and water management practices, cropping and livestock management and natural resources management, within the limits of their own resources, vision and motivation. This provides a viable model for CCA implementation and financing at smallholder level.

Recent participatory impact assessments have shown remarkable improvements in resilience in the space of just one to two years of focussed local action.

Introduction

A current Water Research Commission adaptive research process entitled "Collaborative knowledge creation and mediation strategies for the dissemination of Water and Soil Conservation practices and Climate Smart Agriculture in smallholder farming systems" is exploring best practice options for climate resilient agriculture for smallholders and evaluating the impact of implementation of a range of these practices on the resilience of agriculture based livelihoods. Alongside this, a decision support methodology and system has been designed to assist smallholders and the facilitators who support them to make informed and appropriate decisions about choices of a 'basket of options' for implementation at a local level.

The research process is broadly divided into three elements for purposes of clarity, although all three elements are tackled concurrently:

1. **Community climate change adaptation process design**
2. Climate resilient agricultural practices and
3. A decision support system.

In this article we focus on the design of the community level process.

Community climate change adaptation process design

This consists broadly of:

1. Situation and vulnerability assessments; baselines and farmer typologies
2. Climate Change dialogues; Exploration of climate change impacts, adaptive strategies and prioritization of adaptive measures and
3. Participatory impact assessments: Resilience snapshots

NOTE: The vulnerability and participatory impact assessment methodologies will be discussed in two follow-up articles

Climate change dialogues

A participatory methodology has been developed to allow groups of farmers to explore the impacts of climate change, potential adaptive strategies and to prioritize local adaptation measures. Seven community level

workshops have been conducted across three provinces, involving around 250 participants. The table below provides a summary of this community level analysis

Table 1: Summary of climate change impacts from community level workshops (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
	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 the impacts discussed were similar across the three provinces, the severity of these changes are a lot more obvious in Limpopo.

From these impact diagrams community members discuss adaptive measures and strategies; what they have already tried and what they would like to try. Here the new ideas or innovations can then be introduced by facilitators, as they are requested by the community members. The table below is illustrative and are the adaptive measures suggested by the participants in Turkey village (Lower Oliphant's' Basin – Limpopo)

Table 2: An example of potential adaptive measures from the Turkey (Limpopo) climate change dialogue process

Turkey CC workshop; December 2017			
Impacts	**Description and linkages**	**Outcomes**	**Potential adaptive measure**
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,
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	Increased vulnerability of the people, forced to move to urban areas	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 Plant fodder for livestock
Soils	Poor cultivation practices, soil erosion, dry soils, sandy soils		Using crop residues and manure, conservation agriculture, mixed cropping
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

A list of specific practices is summarised from these discussions and categorized into the five climate resilient agriculture themes. An example is given below of this process conducted for a learning group from Ezibomvini Village in Bergville, KZN.

The following table outlines the practices and their categories

Table 3: Suggested practices for farmers, categorised into the 5 primary themes.

	Natural RM	**Soil**	**Water**	**Crops**	**Livestock**

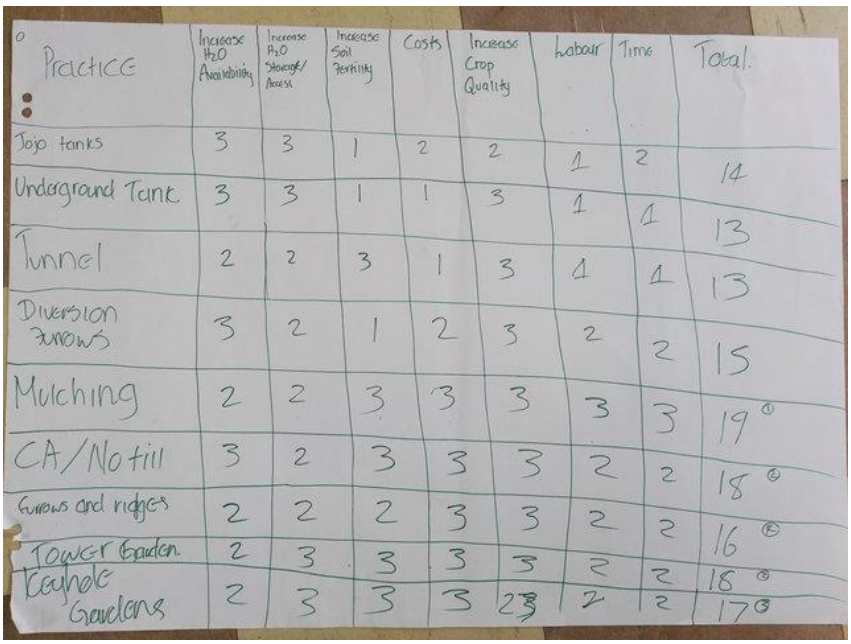
Shade Cloth Tunnels					
Bed design					
Mulching					
Natural pest and diseases					
Rainwater harvesting					
Trench bed					
Composting					
Conservation Agriculture					
Fodder crops					
Underground water tank					
Mixed cropping					
Conservation of wetlands and streams					
Burying of disposable pampers					
Reducing burning of grazing veld					
Greywater use					

Participants then prioritize these practices in order of importance for implementation and change as a group. This depends on local conditions such as drought, harsh weather conditions and the like. The preference ranking for this group was as follows:

1. Underground rainwater harvesting tanks
2. Shade cloth tunnels
3. Trench beds
4. Mulching
5. Natural pest and disease control
6. Mixed cropping (fields and gardens)
7. Compost
8. Fodder crops
9. Conserving wetlands and streams

Right: Sylvester and Temakholo from MDF, facilitating the prioritization of practices

It is also possible here to do a matrix ranking exercise where you elucidate from the groups their criteria for prioritization of practices, which is a very important step in the community level decision making process.



Practice	Increase H_2O Availability	Increase H_2O Storage/ Access	Increase Soil Fertility	Costs	Increase Crop Quality	Labour	Time	Total
Jojo tanks	3	3	1	2	2	1	2	14
Underground Tank	3	3	1	1	3	1	1	13
Tunnel	2	2	3	1	3	1	1	13
Diversion furrows	3	2	1	2	3	2	2	15
Mulching	2	2	3	3	3	3	3	19 ①
CA/No till	3	2	3	3	3	2	2	18 ②
Furrows and ridges	2	2	2	3	3	2	2	16 ④
Tower Garden	2	3	3	3	3	2	2	18 ③
Keyhole Gardens	2	3	3	3	23	2	2	17 ⑤

Right: A group level matrix using community defined criteria for prioritizing climate smart/resilient agricultural practices to be tried out (Thabamhlophe village, Estcourt, KZN, 2018)

This provides a broad action plan for implementation, which is developed further into an individual farmer level experimentation plan. Participants choose from these prioritized practices which ones they will try out in their own homesteads and devise a broad plan of how to intervene in the communal activities such as conservation of wetlands. This process also provides a good agenda for securing external support from role players in the development sector (government Departments, Municipalities, CSI and NGO funded projects).

In a follow-up article we will explore all the CRA practices that have been implemented by the communities to date and the impact of these on their livelihoods.