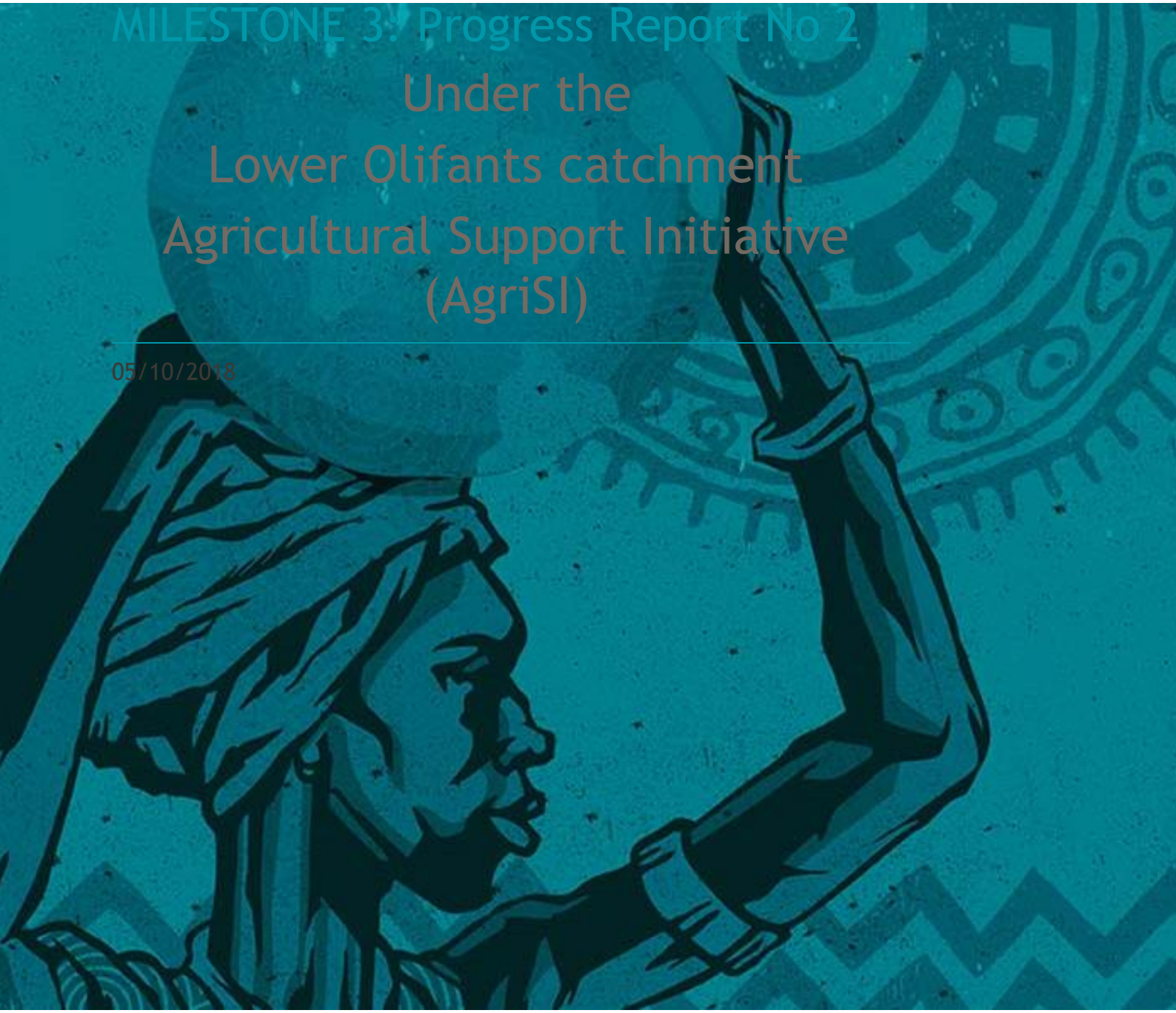
RESILIM-O:
Resilience in the Limpopo Basin Program– Olifants



MILESTONE 3: Progress Report No 2
Under the
Lower Olifants catchment Agricultural Support Initiative (AgriSI)

05/10/2018

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FROM THE AMERICAN PEOPLE

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ABOUT USAID: RESILIM

USAID's Resilience in the Limpopo River Basin (RESILIM) program addresses ongoing degradation in the river Basin in southern Africa, where people face water shortages, increased floods, and declines in crop productivity as climate change further stresses an already water limited region.

There are two components to the program; one operating at a basin-scale (RESILIM-B, which is implemented by USA-based Chemonics and addresses similar issues at the scale of the four SADC member states that share the Limpopo Basin (South Africa, Botswana, Zimbabwe and Mozambique) and a catchment-scale project (RESILIM-O) that It is being implemented by the Association for Water and Rural Development (AWARD). Both projects share the same overall objectives. You can find out more information on the RESILIM projects on www.usaid.gov website and www.award.org.za.

The USAID's RESILIM-O focusses on the Olifants catchment. The program aims to reduce the vulnerability of people and ecosystems in the Olifants Catchment specifically, by improving how transboundary natural resources are managed. By understanding the systemic causes of vulnerability, including climate vulnerability, it is promoting new ways of thinking and acting to promote integrated water and biodiversity management.

ABOUT AWARD

At AWARD, we recognize that the natural world's resources are limited, and undergoing rapid depletion and transformation. We know current practices of use and management are inadequate to deal with the changes and challenges we are facing. We design practical interventions to address the vulnerability of people and ecosystems, and merge considerations from both environmental and social perspectives. Our approach involves thinking across disciplines, boundaries and systems.

We are working with diverse people and institutions in the water and biodiversity sectors in the Olifants River Catchment to understand the multiple vulnerabilities to change, including climate change. Along with quality scientific contributions, our engagement in the socio-political context of the Olifants River Catchment allows us begin to begin to institutionalize integrated, resilience-based practices, providing a foundation for robust development policy and practice in the in this river catchment, and beyond[1].

The Olifants Catchment: An overview

The Olifants River Catchment falls within the Limpopo River Basin, which is part of an international drainage basin that stretches across South Africa, Mozambique, Zimbabwe and Botswana. In fact, the Olifants River contributes nearly 40% of the water that flows in the Limpopo River making it an important catchment in the system as a whole[2].

[1] AWARD: Annual Report.2016/2017 Financial Year. RESILIENCE IN THE LIMPOPO – OLIFANTS.10/31/2017

[2] As above

AWARD, 2017.

At the heart of this catchment is the Olifants River, a vital artery that flows for 560 kilometres through South Africa and into Mozambique, where it is known as the Rio dos Elefantes in Mozambique.

This mighty river originates in South Africa's Mpumalanga Highveld, flowing northwards before curving in an easterly direction through the Kruger National Park and into Mozambique, finally finding rest in the salty water of the Indian Ocean near Xai Xai, just north of Maputo.

The main tributaries of the Olifants River are the Wilge, Elands, Ga-Selati, Klein Olifants, Steelpoort, Blyde, Klaserie and Timbavati Rivers.

Along with its tributaries, it is one of the six major Lowveld river systems, occupying an area just short of 55 000 square kilometres. It traverses three provinces in South Africa; Gauteng, Mpumalanga and Limpopo. About 3.5 million people live on the South African side of the catchment. In Mozambique, it flows through Gaza Province, which is home to about 700 000 people.

A system under change

Our catchment is the foundation of our livelihoods and development. Yet the river and associated natural resources in the Olifants Catchment are under threat.

Unchecked pollution, inappropriate land resource use, weak and poorly enforced policies and regulations and poor protection of habitats and biodiversity are degrading the Olifants at an alarming rate. What's more, the area is however under threat from factors such as mining for heavy metals, inappropriate land management, rural sprawl and unsustainable use of natural resources. This affects the level of goods and services provided by the ecosystem.

The diverse population groups living in the Olifants Catchment all have one thing in common; they rely on the river and the catchment's natural biodiversity for their livelihoods. This reliance can be direct or indirect. Rural communities rely on it for things such as traditional medicine, grazing and browse, fuel, food and housing materials. Some people in river-side communities harvest reeds, collect water from the river for

washing and drinking and use it for recreational and spiritual practices. Subsistence farmers in Mozambique rely heavily on the catchment's flood plains. There are also large mines and associated industries, large scale agriculture and the wildlife economy, which all rely on a healthy, functioning river system. Often people forget that what they do upstream affects people down stream, sometimes with dire consequences.

The catchment is our home and it is worth investing in its future. The work reported here is part of the ongoing activities of the RESILIM- O project under the grant from USAID: Southern Africa.

Project partners

Mahlatini Development Foundation (MDF) is a small public benefit non-profit organization consisting of rural development practitioners who specialize in participatory learning and action processes, sustainable natural resource management and low external input farming systems, including a focus on rain water harvesting, conservation agriculture, intensive homestead food production, food security, climate change adaptation micro finance and enterprise development.

MDF designs and implements rural development programmes and training processes providing learning processes for adults all the way from semi- literate farmers to post graduate university level. We work in partnership with government and non-government organisations alike. We are sensitive to and mainstream where possible gender, disability and people living with HIV/AIDs

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1 Executive Summary

1.1 Progress for the reporting period

Continuation from reporting for Inception period of Phase II (Milestone 2):

- Training workshops for 1 village (Fenale) in seed saving and crop calendars, 4 villages for herb production and quality control (Sedawa, Botshabelo, Mametja Turkey)
- Tunnel construction in 6 villages (Fenale, Lepelle, Mametja, Sedawa, Botshabelo, Turkey)
- Local marketing initiative for organic herbs and vegetables
- Continuation with water issues exploration workshops in 2 villages (Lepelle, Sedawa), to continue discussions and planning and do community screening of videos
- Garden monitoring; Sedawa, Turkey, Botshableo, Mametja, Lorraine.
- Seasonal review workshop- Botshabelo learning group
- Research study for water productivity and water use to augment implementation

IMPLEMENTATION TEAM

MAHLATHINI: Erna Kruger, Sylvester Selala, Betty Maimela (intern)
AWARD: Cryton Zazu, Bigboy Mkhabela,

2 Project Objectives

2.1 Overview of RESILIM-O Project objectives

RESILIM-O is large multi-faceted, multi-stakeholder, cross-boundary programme to reduce vulnerability to climate change through building improved transboundary water and biodiversity governance and management of the Olifants Basin through the adoption of science-based strategies that enhance the resilience of its people and ecosystems through systemic and social learning approaches. The programme has been running for four years and is being implemented by AWARD (The Association for Water and Rural Development) with funding from USAID.

The Agricultural Support Initiative (AgriSI) was initiated as a sub-grant process within the larger programmed towards the end of 2016. This initiative works specifically with climate change adaptation processes with smallholder communities in both the middle and lower Olifants River basin. In the lower Olifants it is being implemented jointly by Mahlathini Development Foundation and AWARD.

The Agricultural Support Initiative (AgriSI) addresses two of the RESILIM-O programme objectives directly:

i. To institutionalize systemic, collaborative planning and action for resilience of ecosystems and associated livelihoods through enhancing the capacity of stakeholders to sustainably manage natural resources of the Olifants River Basin under different scenarios
ii. To reduce vulnerability to climate change and other factors by supporting collective action, informed adaptation strategies and practices and tenable institutional arrangements.

2.2 Sub-grant Project Objectives

Sound agro-ecological practices for soil and water conservation (SWC) and the ability to self-organise and act collectively are regarded as fundamental for building adaptive capacity and resilience to climate change. Not only do agro-ecological farming approaches require minimum external inputs – which may be expensive and increase dependency if subsidised – but they foster farmers' sense that they can build sustainable futures from local inputs and efforts. With knowledge about the potential impacts of climate change included in the learning journey, farmers can make purposeful decisions around practices such as seed saving and crop-type to plant. This approach supports livelihood diversification – also fundamental for increased resilience – through 'value-added' associated activities such as seedling production, tree nurseries and bee-keeping, harvesting and processing of marula fruits into jam and other usable products.

The overall aim of the Agricultural Support Initiative is to enhance the resilience of the people and ecosystems in selected villages (5-6) in the Lower Olifants River basin, using a systemic social learning approach, exploring the question: *What are you learning about the socio-economic and biophysical characteristics of your environment and how these are changing and how are you able to respond to that*?

The overarching objective of this work is to provide support for increased adaptive capacity and resilience to the effects of climate change for households involved in agriculture in select communities of the Olifants River Catchment through:

- Improved soil and water conservation and agro-ecological practices for increased food security
- Livelihood diversification and supplementation through alternative climate resistant production;
- Increased community empowerment as a result of self-organisation and collective action.
-

3 Milestone Description

3.1 Definition of milestone and purpose

Each milestone and progress report indicate activities under the broad themes of learning and mentoring, introduction to innovations and experimentation, collaborative work and networking undertaken during the reporting period.

The table below summarises these activities against the milestone and indicate achievement of these milestones.

Table 1: **Summary of deliverable completion under Milestone 1: 7 July-10 October 2018**

	Activities planned	Completed?	Expected outcomes	Completed?	Verification documentation	Completed?	Reference
Learning & Mentoring: In all 6 communities each 2 days	Learning & Mentoring: -Learning sessions; *Seed saving and seed banks, crop calendars training *Review of S&WC and CSA, for all groups (1 day),	C	-Learning groups; learning sessions – Seed saving and cropping calendars (willows, The Oaks) -Botshabelo review session	C C	Progress report on outcomes including the following documentation: 1. Photos & photo diaries 2. Farmer work plans 3. Garden monitoring 4. Monthly assessments 5. Cluster activity records 6. Event materials, attendance registers	C	1. Photos in reports and- All photos saved in directories and kept by Erna 2.Farmer work plans are recorded in the garden monitoring forms 3. 44 Garden monitoring forms across six villages 4. In this report 5.Appended to this report 6.Appended to this report
Intro to innovations and experimentation:	-Individual farmer experimentation - prioritized, garden monitoring. -LF training; qualitative quantitative monitoring - Tunnel construction	C	- Garden monitoring conducted for 29 participants across 4 villages, including LF's -Quantitative monitoring undertaken by one LF; chameleons, rain gauges -20 tunnels constructed by LFs and learning group members across 3 villages	C C C		C	
Networking: 1. Local facilitator networking 2. Open days, cross visits 3. Review and planning sessions	-Networking; Participatory video -Cluster network session; Impacts of activities	C	-PV screening in 2 villages, plans for stakeholder involvement	C C		C	

4 Approach/ Process/ Activities

4.1 Summary of activities

This section gives an indication of activities undertaken during the reporting period to achieve the outcomes for this period, time spent and people involved.

Table 2: Summary of activities for the reporting period 9 July – September 2018.

DATE	DESCRIPTION OF ACTIVITY	Time	WHO WAS INVOLVED
2018/07/09	Herb grower's workshop at Sedawa with Hoedspruit Hub	1 day	Betty and Nelson Ngobeni (from HH)
2018/07/10-13	Garden monitoring- Sedawa, Turkey(Sekororo), pendragon continuation	4 days	Betty
2018/07/15-27	Traveling to Pietermaritzburg for video editing – Sedawa and Lepelle	10 days	Betty
2018/07-08/30-3	Garden monitoring, checking of chameleons and tunnels in Mametja, Botshabelo, Sedawa	5 days	Betty
2018/ 08/06-10	Garden monitoring, checking of tunnels, herb growers and chameleons- Sedawa, Bosthabelo, Mametja and Turkey(Sekororo)	4 days	Betty
2018/08/07-09	Limpopo measurements report	3 days	Sylvester
2018/08/13	Briefing farmers of criteria for selecting people who will receive tunnels- Turkey, Fenale, Lepelle, Mametja, Sedawa and Botshabelo	1 day	Betty and Sylvester
2018/08/14	Deliveries of tunnels to all the villages- Turkey, Fenale, Lepelle, Mametja, Sedawa and Botshabelo	1 day	Betty and Sylvester
2018/08/15	Seed saving and crop calendars- Oaks and Fenale	1 day	Betty and Sylvester
2018/08/16	Tunnel construction- Lepelle	1 day	Betty and Sylvester
2018/08/17	First delivery of herbs grown by small holder farmers in the villages at Hoedspruit Hub. Data collection (weather station, chameleons) checking for technical issues & Tunnel construction and drip kits	1 day	Betty and Sylvester
2018/08/18	Tunnel construction workshop- Fenale	1 day	Betty and Sylvester
2018/08/20-22	Report back on PV and walk about- Sedawa and Lepelle;	3 days	Erna, Betty, Sylvester, Big Boy Cryton and Neville Meyer
2018/08/23	Botshabelo mid season review workshop	1 day	Sylvester
2018/08/24	Second delivery of herbs and vegetables to Hoedspruit Hub	1 day	Betty
2018/08/27-31	Garden monitoring, checking of tunnels, herb growers and chameleons- Sedawa, Bosthabelo, Mametja and Turkey(Sekororo). Make a third delivery of herbs and vegetables to Hoedspruit Hub.	5 days	Betty
2018/09/04-07	Organise 4th delivery of herbs and veg, monitoring report, measurements report	5 days	Betty, Sylvester
2018/09/10-14	Organise 5th delivery of herbs and veg,		
2018/09/17-21	Milestone 3 report	5 days	Erna
2018/09/17-21	Fruit tree orders, seedling procurement, travel to Limpopo, monitoring, planning for mango x visit, organise 5th delivery of herbs and veg	5 days	Betty, Sylvester
2018/09/24-28	Deliver seedlings, monitor and organise sales, set up workshops for following week	4 days	Betty Sylvester

Sylvester: 28 days, Erna: 10 days, Betty: 53 days

5 Progress and Results

5.1 Learning and mentoring

Learning processes conducted are summarised in the table below

Table 3: Summary of learning sessions conducted: July-October 2018

Village	Date	Activity	No of participants	Comments

Sedawa, Turkey, Botshabelo	2018/07/09	Herb growers workshop with Hoedspruit Hub	11,1	Hoedspruit Hub provided the first training to herb growers in Sedawa, Mametja, Botshabelo and Turkey
Lepelle, Fenale	2018/08/16	Tunnel construction (2 days); including drip kits, re-cap on trench bed packing and experiment planting inside and outside tunnel	28,12	1 tunnel constructed, with help from Sedawa participants and 4 more done by participants themselves thereafter at Fenale
Lepelle, Sedawa	2018/08/21-22	Report back on PV and walk about(2days)	36,42	Participants loved the video and gave their consent to take the video out, also suggested that we add more information to the video to increase chances of getting funds to assist their community. Videos in final production stages; available end October
Botshabelo	2018/08/23	Review workshop	11	Planning for coming season restricted to gardens with water given continued drought

Learning workshops are conducted as group discussions, starting with local practices and analysing the potential benefits of the new ideas. These are followed by practical demonstrations and an assessment by the learning group related to the activity. The table below includes some of the comments made by participants.

Table 4: Comments from participants on new practices introduced in learning workshops

Practise/Activity	Comments by participants	Visuals
Mulching	• Mulching helps water management, because it reduces soil moisture loss. • It helps by reducing evaporation and increase infiltration. • It also helps to improve soil fertility and protect their seedlings • We use dry tree leaves and grass	
Planting herbs	• We did not know the uses of herbs and types of herbs. • We grow coriander, parsely, basil, fennel and rosemary • Coriander, basil, fennel and parsely grow very well in our soil, but rosemary doesn't • People in the community are getting familiar with using these herbs and are now buying them from us	

Mixed cropping	• Traditionally this was done in fields • In gardens having the same crops together looks presentable and helps with harvesting – awa having enough to sell • Companion planting sounds quite complicated • We did not know that this can help with pest control	
Tunnel experiment	• Participants explained that vegetables inside the tunnel grow bigger than the ones planted outside the tunnel • They also acknowledge that water loss between the trench bed inside tunnel and outside tunnel differ • We water more outside the tunnel than inside the tunnel	
Field cropping (Sedawa)	• Participants intercrop vegetables • They also plant herbs in their field crops • They use water from the mountain to water in their field • They plant diversified crops, sweet potatoes, maize, cowpeas, cabbage, spinach, tomatoes, onions	
Tunnel construction	• Participants mostly female came in numbers to design a drip kit and a tunnel. • They learnt how to sew the net, how to bent the pipes using a jigger, and how to connect the steel pipes learning about the depth and how to measure the hole in which support the tunnel.	
Record keeping of is been sold	• We use our two hands as a scale to weigh the right weight when selling spinach. • It also depends on how big the leaves are if they are small a bundle will be big and if the leaves are big, the bundle decreases. • We don't know how to use a scale and we fear we might forget how to use the scale.	

Herb growers	• Herb growers attended a training workshop on herbs production and marketing • Farmers are happy to be part of the Hoedspruit Hub market and are ready to sell their herbs and vegetables • They are already growing herbs in their garden to sell • Some farmers also dry herbs and sell in the community • We are thankful to Hoedspruit Hub, Mahlathini and AWARD for all the help and support that they are giving us. • We hope that the market will grow and we will have water to also grow our gardens so as to have more to sell.	*Herb grower Lina Malepe preparing herbs(coriander and flat leaf parsely) for delivery to Hoedspruit Hub.* 

5.1.1 Botshabelo – Mid season review and planning

Date of workshop: 23 August 2018 (11 participants)
In this session the learning group reviewed all practices that they are implementing. The table below summarises their comments

Table 5: Summary of reviewed practices for Botshableo: August 2018

Practices used by members of learning group	Name of participant and what they have tried	Comments
Bed designs • Deep trench beds • Shallow trench beds • Eco-circles **Soil and water conservation techniques** • Diversion ditches • Use of line level in making furrows • Banana basins (local practice) • Rain water harvesting	**Mariam Malepe:** Planted herbs in an eco-circle, experimenting with the trench beds in and outside the tunnel, a tower garden demonstration was done at her homestead (she is no longer using it). She has now made shallow trench beds and planted mustard spinach in them which is growing well). She has also planted in and on the diversion furrow made during a workshop. **Mosebu Ntlhamo: R**ecently planted tomatoes in basins and put mulch on top- she says this is more effective and saves water, given that she must pay for the water. She used to collect runoff water into banana basins, there is no runoff to collect and the banana trees are now dead) **Mamodupi Nthlamo: T**ried several things including fodder production, planted the winter mix seeds **Dibonanna Mokgotho:** She states that deep trenches, especially those in the tunnel, are very good, crops in grown on these beds grow better with	Deep trench beds: these beds are doing very well and save us water, especially those in the tunnels Shallow trench beds: these are easier to make than the deep trenches and also are good at saving water and improving soil fertility Eco-circles; these beds work very well when there is a severe limitation on water. Diversion furrows: we take a reactive approach when it comes to issues of controlling soil water movements (we more likely try this once we get a lot of rains and erosion becomes a problem) Regarding rainwater harvesting: there is just no water to harvest Banana circles work well during the rainy season; but it so dry now that some of these bananas have died.

	the limited amount of water we apply, **Siliki Malepe:** Eco-circle, help me grow with the little water I have **Mokgowane Marwale:** She is trying a combination of things, from eco-circles to bed trench beds **Rebone Malepe:** She has only tried eco-circles and she praised them for being easy to make and being efficient (saving water and adding fertility to the soil)	
Soil fertility options • Application of manure (quantities and time of application) • Liquid manure	**Mokgowane Marwale** and **Mamudupi Nthlamo**	-They both have tried liquid manure using kraal manure and commented that it works well (vegetables growing on beds where we added liquid manure grow well and are of good quality) -We have increased the quantity of manure we apply in our garden and we learned that manure (especially when is still fresh) absorbs a lot of water
Disease and pest control option • Pest control remedies	**Seemole Malepe**, **and Mokgowane Marwale** have used aloes to make pest control remedies	General comment: making pest and disease control remedies depends on presence of pests (if pests are not present, we never get to try this). And chances are, with time we are going to forget how to make them (also considering that we sometimes confuse them with teas and liquid manure)
Drip kits	None in operation now	General comment: we still need some assistance on how to make and manage them
Tunnels	Two people have tunnels; **Mariam Malepe** and **Dibonanna Mokgotho**	Tunnels work very well to keep moisture in the soil, and protect plants form excessive heat and wind. Along with the trench beds which improve fertility crops in the tunnels do a lot better than those outside.

General comments about the bed designs

- Participating farmers have observed that most of the bed designs introduced through the AgriSI project uses lot of manure and have added some fertility to the soil (as a result crops growing on these beds grow faster and are of good quality). Seemole has observed that beetroot growing in a shallow trench bed grows much better than the traditional way of planting on ridges.
- For the tower garden, from the demonstration they have seen it work. It looks complicated to build though and requires teamwork and inputs, so we have not tried it ourselves.

Areas where participants are still struggling:

- Joint activities; Due to lack of teamwork amongst the participants, those activities which requires group effort are hard to implement. Participants think they still need MDF to lead joint activities e.g. tunnel construction and tower garden, as they are not yet at the stage where they can do this on their own
- Drip kits; It will be useful for MDF to do another workshop on this
- Herbs; We tried the herbs and we see they grow well but we just didn't know what to do with them. We didn't grow enough to be able to join the group that is now selling. We would like to have a

workshop on how to use the herbs and if possible have a cooking session where you introduce some dishes that are cooked with these herbs.

Options for expansion:

- We would like to increase the size of plots where we experiment with some of the innovations but lack of access to water is a major obstacle
- We are hoping the coming season will bring use some rain, so we can start growing more

Figure 1: Tomatoes planted in basins and mulched at Mosebu Nthlamo's homestead

Way forward:

- Christina and Magdeline to come and assist with construction of tunnels in Botshabelo
- To set up a workshop on use of herbs and design and management of drip irrigation systems

5.1.2 Tunnel construction

The introduction of the 5mx4m shade-house structures to selected participants in the community was continued in this period, with provision of another 20 tunnels. In particular, introduction of this process in villages where we had not done so to date was prioritised, as was provision of 'tunnels' to those who did not receive them in the previous round. The selection criteria were re-introduced and discussed in a workshop process

Demonstration of tunnel construction was done for the learning groups in Lepelle and Finale, after which they continued with further construction. The LF from Sedawa – Christina Thobejane and a learning group member Magdeline Malepe assisted in these processes.

In total, 18 tunnels were distributed to participants, one has been bought (by Christina Thobejane) and one is still available for allocation.

The table below indicates the beneficiaries for these tunnels.

Table 6: Beneficiaries for the 2nd round of introduction of tunnels; August 2018

	Name of participant	Village name	Comment
1	Sopna Mashilo	Fenale	
2	Norah Moropane	Fenale	
3	Endina Mobela	Fenale	
4	Sarah Nyathi	Fenale	
5	Alucia Monareng	Fenale	
6	Mamudupi Ntlhama	Botshabelo	

7	Seomole mokgotho	Botshabelo	
8	Matsenyego	Lepelle	
9	Sarah Madire	Turkey 2	
10	Lydia Shai	Turkey 1	
11	Maria Tshehla	Turkey 2	
12	Mphelesi Sekgobela	Sedawa	
13	Joyce Seotlo	Sedawa	
14	Meisy Mokwena	Sedawa	
15	Lina Malepe	Sedawa	
16	Christina Thobejane	Sedawa	(bought this as her 2nd tunnel)
17	Winnie Mametja	Mametja	
18	Thaini Mashinya	Mametja	
19	Marta Moloto	Mametja	
20	Unallocated		Potential for another participant to buy

5.1.2.1 Progress for tunnels in Turkey

4 Tunnels were constructed in Turkey one towards the end of 2017. Below are some photos of progress and innovations from the participants

Figure 2: Above: Spinach in Sarah Mohlale's tunnel, Right and Far Right; Spinach and onions beds outside and inside Mtashego Florence Shaai's tunnel. Insert: Florence dried her coriander, as it matured prior to the sales arrangements being in place. She sells this dried herb by the teaspoon full.

5.1.3 Innovations and Experimentation

The progress for tunnels and tunnel construction have been reported in the section above. Garden monitoring has continued in this quarter. Summaries have again been made of local innovations and introduced innovations being practiced by participants (see section 4.3 of this report). Garden monitoring has been conducted for Turkey, Sedawa, Mametja and Botshabelo.

5.1.3.1 Turkey garden monitoring

Turkey is another village with a desperate water situation, but they came together in to collect money and buy their own pipes to fetch water from the mountains for both consumption and watering their gardens. They also hired a person to maintain their pipes and ensure that they get water twice a week and they pay

R70,00 per household for this. Each group consists of around 10 households. Some of our participants get water for both drinking and watering their gardens from a spring across the main road.

From their gardens they can sell vegetables like spinach and Chinese cabbage, beetroot, beetroot leaves and tomatoes. In a month they can generate around R400,00 per household. Participants also plant herbs and they use practices introduced in the AgriSI learning sessions.

left: A picture of a well in Turkey from across the main road not far from the clinic which provides water to a number of households in Turkey, including one of our participants Dinah Masete from Turkey 1. She collects water for both consumption and watering her garden from this spring. Right: is a spring protected by one of the participants, Elphias Machete also from Turkey 1. He also collects water from a nearby river to water his vegetables.

Clockwise from Top Left: Sarah Madire's (Turkey 2) trench beds. She planted kale, spinach and mustard spinach (from seed provided through AgriSI.

Norah Tshetlha (Turkey) holding beetroot she planted in her trench beds.

Trench beds planted to onions, carrots, beetroot and mustard spinach.

5.1.3.2 Sedawa and Mametja garden and field monitoring

Sedawa and Mametja also face a desperate situation; lack of water and they have set up a water committee, which is working with the AgriSi team to explore options for their group. Through garden monitoring the reality of water shortages was obvious. Participants are struggling to farm as they need to buy water for both consumption and watering their gardens. Not all hope is lost as there are participants with a passion for farming and who are actually farming in their small gardens with little that they have.

In these group there are a few farmers with bigger plots outside the village; about 4 -6 hectares. Farmers with big plots either have borehole water or they use water from the mountain to water their vegetables. In their plots they plant different vegetables and one participant also planted the herbs (parsley, coriander and basil) in his field.

Pictures above: Obridge Tshetlha uses his field to farm a variety vegetables (sweet potatoes, tomatoes, spinach, beetroot, cabbage and herbs to sell. He is not working so he depends on this field for a living. He also joined hands with his family and other farmers, farming close buy, to collect water from the mountain and share the water in their adjoining fields.

Mr Maphori, farms with his wife and his son in another field. He has borehole water in his field. They plant a range of vegetables (cabbage, tomatoes, onions and spinach) and sell in the community. This is their main source of income.

Right and far right; The Maphori family members in their field tending cabbages and tomatoes

Smallholder farmers participating in the AgriSI project love growing tomatoes in their household gardens as they believe it has good market. Almost all the participants monitored have planted tomatoes. Depending on the size of tomatoes they sell a bundle of 10-15 tomatoes for R10,00. Tomatoes are a basic food in their community so they can sell close to 5 bundles a day and there is enough demand for all to be able to sell. Participants make between R150,00-R400,00/month selling tomatoes in the community. Mostly they use the traditional furrows for planting tomatoes and are now aware that they would need to rotate this crop with other vegetables to reduce the incidence of pest and diseases.

Above Left: Nancy Malepe (Mametja) has tied plastic packets to her tomato stakes to discourage birds. Above Right: A plot planted to tomatoes at in Odinah Mayebela's garden (MametjaA). She loves planting tomatoes in her garden. She is one of the participants who gets water from the mountain through a local arrangement. Presently the flow is very low and she can only fill 3x 210l litre drums a day. She uses the water for both consumption and for watering her garden.

Above: Tomatoes harvested from the small gardens in Sedawa and Mametja ready to sell.

5.1.3.3 Report back on Participatory Video and the walk- Sedawa and Lepelle

These were the 2nd round of workshops conducted in these two villages to support the local community initiatives around water provision for agricultural purposes.

Agenda

INTRODUCTION
- Recap process; water issues workshop water-walk, progress and issues in the meantime
- Video making process

VIDEO SCREEENING
- Screen video
- Discussions:
  - Does this movie present your situation and conversations well?
  - Any additions of changes?
  - How can this movie help us? Who can we show it to? Purpose? Process

REPORT BACK- WATER WALK
- Chris's reports and suggestions presented
- Discussions, scenarios, options, alternatives
- Rate scenarios
- Follow-up actions

5.1.3.4 SEDAWA Water issues Workshop 2

5.1.3.4.1 Introduction

Some of the learning group members went to speak to people in Botshableo who have done this before (protected a spring in the mountain and reticulated with pipes in the village). In that case only 8 of all the initial 'volunteers" went ahead with the process. But technically it seems feasible. If he can do it, so can we.

The strikes and road blockages in the area as because of water issues. It appears to be

the only way to get the Municipality to hear us the municipal borehole pumps are broken; there are maintenance issues. The municipal water trucks that deliver water do not come to this village- so there is presently no water at all. The Maruleng Municipality is quite small and only have 2-3 water trucks, which are not enough to service all the areas. There are rumours of them combining with Phalaborwa.

Figure 3: Sedawa community meeting- water Issues workshop 2, with Neville Meyer in attendance to assist with the video screening aspects.

No one has been informed of the impending bulk water supply system, although they have seen the pipes being laid along the main road and some of the big new reservoirs built on the hills. There is no direct communication form the municipality. We can only hear news via the radio/ newspapers. The meetings that do happen are about votes, they are not real things. There is friction as they make promises that they do not fulfil.

Different scenarios were discussed

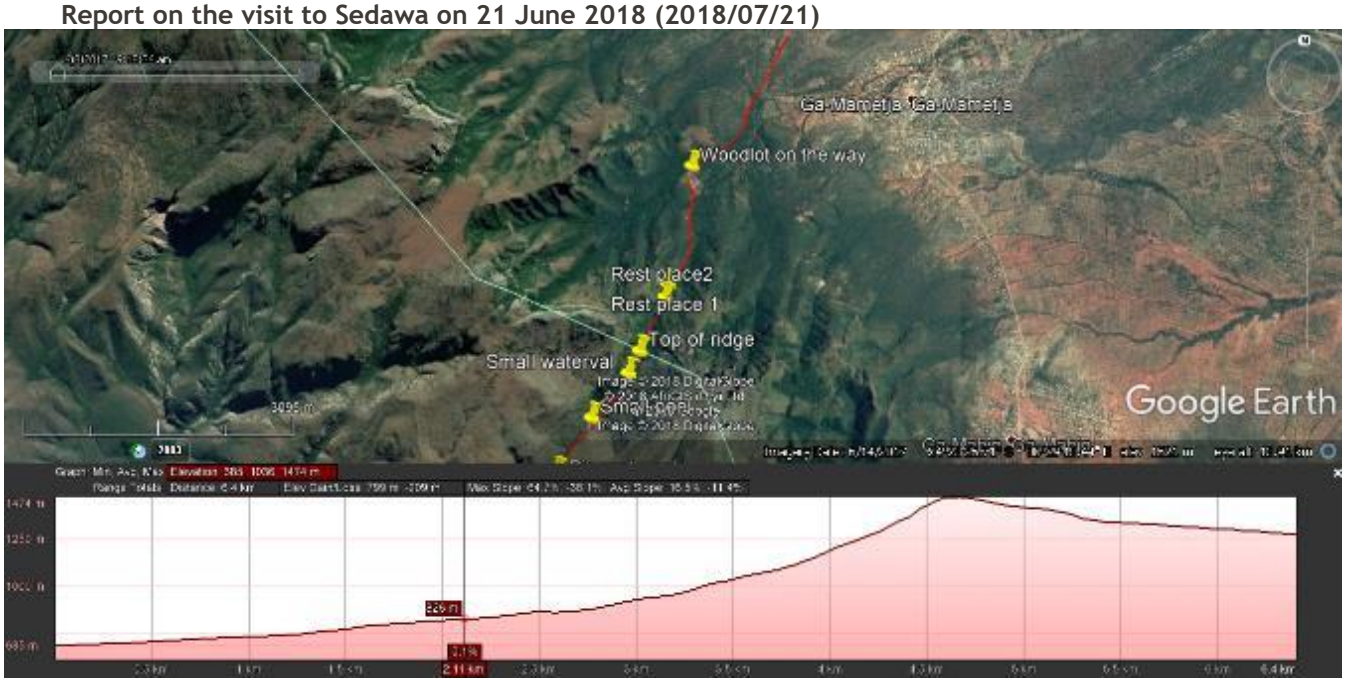
1. Divert water from the Olifant's river and bring it through Botshabelo to Sedawa – it is a shorter route than the mountain spring
2. The alternative spring at the foot of the hills in Sedawa (we passed the infrastructure and irrigated gardens on the way up). The group felt that they could communicate with him, but there is a practice in the area, that if someone discovers a spring and uses it first, it even gets' their name, so it becomes a bit of a challenge. There were conflicts before that eventually had to be sorted out by the tribal authority. It might get to that here, or it might be better
3. We still need to take the walk around the mountain to see how far it is (Maphikiri). We do not yet want to let go of this option. We would need to run the pipe around the back of the mountain through Botshabelo and then bring it here.
4. Boreholes, maybe three separate ones to be able to take pipes from there to the various participants, who are in three separate areas. The fear here is that some boreholes are running dry and sometimes people drill and do not get water.

5.1.3.4.2 Comments on the screening of the movie

1. The movie is perfect as it is
2. It's a nice way of keeping a record of what we did
3. It was a very long walk, hopefully it will bear some fruit
4. Thirsty from seeing that water- this video is giving us encouragement and hope
5. We've seen the water- now let's go get it
6. We are seeing how steep the slope is, the pipe will have to go around
7. The way it looks, the source seems small, but I know from the past that it is a very good source
8. This video can be used to show prospective donors
9. Just the effort we took should impress the funders
10. We can go as far as the premier and the president's office. We need to start at the top and work down as the local officials are corrupt and do not care about us.
11. It is a tool we can use with the municipality to negotiate what we need.
12. Government officials at different levels can be contacted including DWA
13. We can find a way for you guys (MDF and AWARD) to enter- to help us with this as we know a few of these people personally
14. The Motsepe Foundation is a potential funder
15. We can show the tribal office what we are doing here
16. Nicholas Sechaba does TV programmes to get more attention
17. We could also go to MamGobosa at the Daily Sun newspaper
18. Nothing comes easy – this shows our first steps towards making things happen

5.1.3.4.3 Water walk report back

Report on the visit to Sedawa on 21 June 2018 (2018/07/21)



Background

The village was visited on 21 June 2018 to look at possible sources of water for vegetable production for about 30 participants of the project. The local villagers wanted to show us a water source at the adjacent mountain and we walked with them the up the valley over the water shed to the other side of the mountain. We started walking at about 07:30 and returned at about 18:00. The distance that we walked was 6.4 km one way and the elevation about 790m. The villagers suggested that a pipe be installed from the river on the other side of the ridge around the mountain. This may be possible although the terrain is likely to be very difficult. The estimated distance would be more than 12km and to install a gravity pipe with a constant gradient would be very problematic. The height difference of about 600m is also very challenging as the excess pressure would need to be nullified with the use of several reservoirs along the pipeline.

Recommendation

The 12km pipeline around the mountain will be technically very difficult but the cost would be prohibitive. A rough costing indicates that the costs for this option could be in excess of R3m. This option is therefore not recommended. The option of taking the route that we walked is also not recommended for the same reasons with the added complication that the water would need to be pumped.

The amount of water is also not much and the flow rate at the time of visit was estimated to be between 5 and 10 m^3/h.

It is therefore recommended that a much more cost effective and practical option be considered. In my opinion a borehole would be a far better solution to develop a water source. It would need to be managed in such a way that it is sustainable and equitable. These problems could be overcome with clear definition of roles and responsibilities based on sound management and maintenance.

Water Group

22 people have contributed R 9000 towards the proposed water system. There are around another 50 people who are waiting to see what happens.

Min water required:600l/hh/day
Gardens: 250 000l/week (fill up whole yard with trench beds, 50 hh)
Fields: 420 000l/week (Ave 3,6ha, 8 hh) (THUS AROUND 700 000l/week)

SPRING: 10 000l/hr ~200 000l/day = 700 000- 1 400 00l/week
(COST:R1,5-3million)

BOREHOLE: 2 500l/hr ~ 175 000l/week (will need 3-4 boreholes) (***COST R150 000-R300 000)***
* this was based on Christina's borehole =, which is strong and fills her 24 000l tank in 10 hours

5.1.3.4.4 SUMMARY AND DISCUSSIONS

Summary: the spring as it is now supplies around 10 000l/hr, which is not very strong. The distance the pipe would need to go is 12 km (around the mountain) and the spring is 800m higher than the village. This provides too much pressure for a pipe and "breaker" tanks and pressure release valves would need to be built along the way. The overall estimated cost is around R3 000 000. SUGGESTION: Communal borehole that belongs to the group.

5.1.3.4.5 COMMENTS

1. I agree with the borehole option. It could make sense to drill them in Mametja A and then bring the water to Sedawa
2. R3 million sounds scary, but maybe we can break down these costs and start step by step
3. It the source is not so strong, maybe we can build a wall and collect water to get more
4. There are boreholes that aren't yielding that much water. Up there we are sure there is water, so let's explore
5. We can use different classes of pipe, even class 6
6. Going for a borehole is going one step backwards – let's go forward rather
7. We've set our sights on that water, so let's keep going
8. There are a lot of people with boreholes that are not giving good yields. Do we have goo ways of detecting whether boreholes will be strong or not?

5.1.3.4.6 COMMUNITY HOMEWORK – end of September

Go and visit people with boreholes to find out

- When it was drilled
- Who did the drilling
- How deep it is
- Yield – l/hr
- Does it change in winter and summer; is it getting weaker
- How did you decide to put it there

And find some places to provisionally site 3 boreholes based on this information and on where we think there most likely is water (ie close to the riverbed) (get GPS coordinates for those spots – Betty can help with that)

MEETING 1: We need to meet to discuss the options more (23 August)

OPTIONS	Next steps	What we still need to know or do
Boreholes		
Shorter term, more manageable, but there may not be enough water	How will they be distributed? Group people into areas? Pick water sources and number of people TEST WATER	Siting? Quality of water? Operational costs, who will pay for maintenance.? Who will open and close the taps/ pumps? Fixing pipes and pumps (We are starting to earn income from our gardens and can contribute)
Mountain spring		
Longer term. There is a danger of burning of pipes There is not clarity in the longer term how much water there is	Are there cheaper ways? TEST WATER Organise a meeting for the man from Botshabelo to explain his process, costs, issues etc. Get Chris to do quantities	Steel pipes may be needed, but this could be very expensive Need to walk along where the pipe will be. And talk to the man from Botshabelo again. There is the concern that 205 needs to be left for the environment.

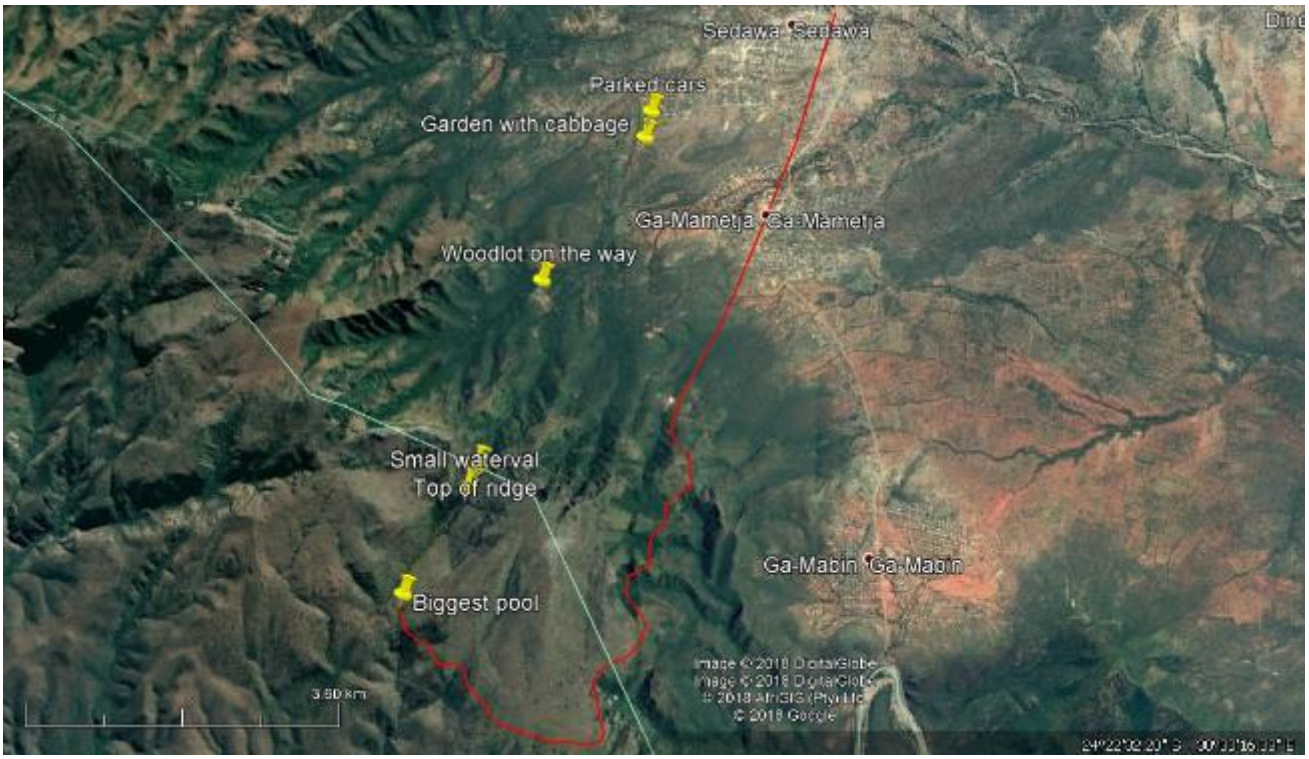
Dipua Thobejane is the Muaruleng Mayor – he can be approached
Also Rebecca Malepe is the councillor and she can be informed. To see if they will provide support
Lebo from DWA can also be contacted

COMMENT: Cryton: the municipality needs to be informed as it is under their jurisdiction – so that there are no legal repercussions. And you will need to specify that it is water for agriculture, not household use

5.1.3.4.7 MAHLATHINI/AWARD HOMEWORK- end-September

- Are there good drilling companies in the area, and which are they
- Is there an underground water survey for the area
- Costs of an exploration/survey (or water divining)
- MDF is in the process of writing a funding proposal, which will be able to assist with the funding (not R3million though). We will know by end November whether that is possible
- Derrick/ William from the municipal support unit in AWARD – can show the video

SEDAWA-MORE DETAILED COSTING OF THE PIPE FROM THE MOUNTAIN (2018/09/02)



The above Google Earth map shows the path of the possible pipeline from the biggest pool to the middle of the village of Sedawa. The length of the path is 12km as indicated. The total height difference is 680 m from the pool to the centre of the village.
This means that 6 5000litre plastic tanks on stands will have to be constructed to prevent the pressure of building up. A class 12 HDPE pipe will have to be used. This pipe will be vulnerable to vandalism and veld fires and should be buried or protected.
The cost estimates are as follows:
The first 7km has a fairly flat slope and to be able to get at least 3000 litre per h a 50mm pipe will have to be used. Cost R250 000
The last 5km can be a smaller pipe as the slope is much steeper – 32mm HDPE Class 12: Cost R100 000
Installation for 12km at R150/m: Cost R1.8m This will very likely be much more than this estimate.
The 6 tanks are R5 000 each and their stands are about R10 000 each: Cost R 90 000
Erection of these tanks: cost R180 000

Contingencies: R180 000
Total estimated cost: R2.5m

5.1.3.5 Lepelle Water Issues Workshop 2

Figure 4: Lepelle community meeting at the school; water Issues workshop 2 (above) and watching the video made for th1st workshop and the water walk (below)

5.1.3.5.1 Introduction

The water committee attended a traditional council meeting. The agreement is still a 50kg bag of cement per household. A committee member has been tasked with making a list of people interested in access to water from the furrow, plus those who are willing to make financial contributions. Another meeting with the council planned after this feedback meeting from MDF
The water committee was accepted by the TA and it now has 9 members. (4 more members added by the TA)

A question was asked whether MDF can assist with trying to raise funding: in answer MDF is in the process of writing a proposal to the Govt of Flanders which will leverage some funding (not a very large amount, but enough to assist with the present plan) and also can write a proposal to a private funder (details provided by Neville) who assist with community water projects.

The group reiterated that they also need assistance with planning and advice to do the repairs.
There was a question as to whether MDF and the engineer walked the whole length from start- end. Apparently, the furrow ended much further along – below the second school and not at the first school as presently indicated in the report back.

5.1.3.5.2 Comments on the screening of the movie

- We like it, but there was a lot of mention of drinking water (Did you only get the tip about this needing to be agricultural water after you made the movie?)
- Also want to include the mango trees
- We can use it to attract funders for the water stuff
- The water committee and tribal authority should also have a copy
- If we use it for funder we need to do a lot of cuts to show how we use it for farming and not “sharing the water with the baboons”.
- There is support for purifying this same water from government. The dept of Health (Matilda Ledwaba) have done trainings on purification of water as part of a typhoid fever awareness raising programme
- There is municipal water supply – 5 boreholes with pipes and taps. It is however not enough and often the pumps break and then there is no water for long period
- We can share this movie with outside stakeholders- but it must be prettier first and we want to see the updated version first
- We need some more shots of the impact of the shortage of water- some shots from the “drier” side of the village would be good

- We should show some of the farming activities - may need some more footage of this as there is some of George's homestead and orchards only. We need to include all household activities including making bricks, building , washing etc
- Want to include a bit more around the municipal supply

Action: Three volunteers to join Betty and Neville after the workshop to take more footage: George, Patricia, Joyce

5.1.3.5.3 Water Walk report Back

Furrow Inspection Report and Recommendations (2018/08/05)

The village was visited on 22 June and the furrow was inspected by CM Stimie, guided by some villagers, from the village up to its source at the Tshwenyane River.

Description

The furrow is about 1km in length from the inlet from the river to where the furrow is still visible. In the 1980's the furrow extended another 0.7km to be able to serve the whole village. It also had a spill into the Olifants River at its end.

The furrow is being maintained by the villagers and from the way they speak about it and how the look after it, is it evident that this furrow is very important to them. They estimate that it was built in the 1920's. There are number of leaks which cause the flow in the furrow to decrease over a distance.

Recently villagers started to install individual pipes in the wall of the furrow to take the water directly to where they want it. At one place 13 of these pipes are placed next to each other. It is estimated that there are 30 to 40 of these pipes installed taking water from the furrow. This resulted in major wastage at the end of these pipes as these are left open when not in use. People at the end of the furrow only get water by arrangement as the furrow is normally dry for the last 200m or so. There is some conflict in the village around the distribution of water from the furrow.

Recommendations

Repair of Leaks

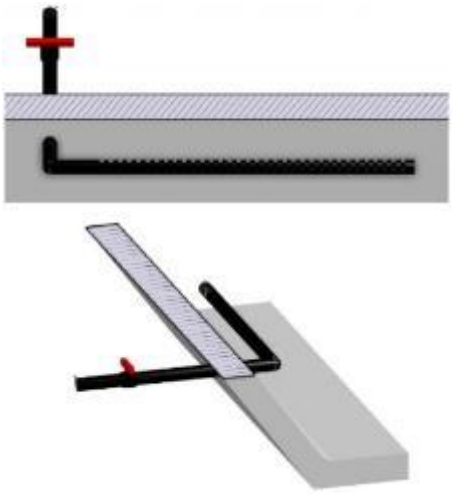
The major leaks in the canal should be repaired to enhance the effectiveness of the furrow. Villagers have been maintaining the furrow for years with soil and sometimes with ferro-cement and developed a working skill for these maintenance activities. These repairs are usually of a more temporary nature, mainly because of the lack of funds. The equitable distribution of water is however a major challenge. The over extraction of water needs to be regulated with a technical solution and a management system in order to curb wastage as far as possible and to provide water for production to as many as possible.

Bentonite could be used to repair smaller leaks. This method will have to be demonstrated on site. The cost of bentonite is R150 per bag of 40kg. Five bags to start with will be sufficient to test the system. There are places where more severe leaks occur. These leaks have to be repaired by lining the whole width of the furrow for a few metres or at least replacing the leaking earth wall with ferro-cement. The repair of these areas could be done by the villagers but if the engineer is on site direction will be given for these repairs. It is very important to dig down at these places to prevent water finding escape routes underneath the construction.

Water Management

Standard outlets could be constructed in the furrow with consent of all villagers. This will make it possible to manage the water in an equitable way.

The following concept is proposed. It is basically a slotted plastic pipe which takes water out of the furrow, through the wall while being regulated by a plastic valve. The total material cost for this system is less than R250 when it is bought at the best prices in bigger centres. See sketch alongside.



Description of the proposed concept:

It must be noted at the outset that this concept should first be tested on site before implemented on a large scale. When people have used it and is happy with its operation they should be willing to agree to use it as an equitable management system to match the technical system.

The technical system description is as follows: It is proposed that only controlled offtake s are installed in the furrow. These will very likely look like the sketch above. These offtakes will take the same amount of water out of the furrow and it will be controlled by a valve at the beginning of the pipe and at the end. These pipes would be able to deliver around 1500 litre/h and if the flow rate in the furrow is 15 000 litres/ h only 8-10 of these pipes should be opened at the same time. The flow rate of the furrow during the time of the visit was estimated to be between 10 000 and 20 000 litres/h.

The offtake position(s) will need to be concrete lined in a form of a rectangular canal to enable proper functioning of the off take pipes and ease of maintenance. A length of 10m is proposed for this purpose. The thickness of the lined furrow (wall and floor) should be 100mm. About 10 bags of cement will be needed, as well as 600 litres of sand and 600 litres of crushed stone for a 10m length. (That is 30 x buckets of 20 litres each). Depending on the cost of sand and stone the material cost for this 10m lining will be at least R10 000.

One off take can be shared by 5 to 6 participants. Each participant would have their own pipe and will connect it to the off take system when it is their turn. In this way the participants will get a turn once a week to get water from the furrow. If this is accepted it means that 5 off takes will be able to serve 30 participants, and 7 will be able to serve 42 participants. This needs to be discussed with the villagers.

Estimation of costs

Item	Description	Costs
Bentonite (powder clay)	4x40kg bags @R150	R600
Fix 2 large leaks in furrow	2 x Cement (4 bags, 240ℓ sand, 240 ℓ stones)	R8 000
Offtake basin; 100mm depth of floor	Cement (10 bags, 600 ℓ sand, 600 ℓ stones)	R10 000
Individual slotted pipes with valves (40mm/50mm)	2 x Valves , fittings, 1m slotted pipe, R250per participant x 40	R10 000

5.1.3.5.4 Summary and discussions

The furrow provides around 15 000l/hr. A 40mm valve in the furrow provides for around 1 500l/hr, which is around 30 000l in a 24hr period. If a 50mm pipe is used this pulls out 9 500l/hr (225 000l/24hrs). As the overall flow of the furrow is only around 15 000l/hr 40mm pipes are recommended. In this way 10 pipes can be placed in the furrow at a time.

~40 people with pipes
~5 people using furrow directly
~30 new people who want to put in pipes

Suggestions (cheaper version)
1. Make 8-10 permanent valves or off take points with taps at the offtake basin and at the household (around R200/participant). As there are presently around 40 beneficiaries, it would mean each person would have access to water for a 24hr period every 5-7 days
2. This would then require arranging for storage options at the households
3. Fix the offtake basin and cement in these valves as the first step (~R10 000 -10 bags cement, 600l of sand)
4. Then fix the main leaks in the furrow (R 8 000(cement, stone, sand) and R600 (bentonite)
5. First start with the existing beneficiaries and then think of expanding, when it becomes clear how much water there is (once the leaks have been reduced)

5.1.3.5.5 COMMENTS

- Yes, to money rather than cement
- The more pipes there are the less flow there will be in the furrow. Then it cannot go far – so the decision is around more pipes or longer furrow, but both are not possible. It also means that those further away will need to have longer pipes and it will be more expensive for them
- New people accept the idea of pipes and the greater expense.
- Once things start moving there will be a lot more people wanting water and that could be an issue.
- The committee's first suggestion was to use cement paving blocks in the furrow - why did MDF not quote on that for the whole furrow?
- Our reason for taking the whole stream form the source is because of all the leaks. If we fix the whole furrow then we can leave some of the water in the stream for the reserve
- The problem with not fixing the whole furrow is that leaks will develop again; crabs will make holes in the banks etc
- We were hoping for the "expensive" version, but as it seems that this furrow can never serve everybody in the community, the cheaper option may be better as a group activity, as then we cannot be expected to provide water for everyone (without them contributing)
- We understand that this is a starting point, but most of the contributions have and are coming from those who presently do not have access to the furrow – so that makes it complicated.
- It is good to tackle the issues of leaking pipes as a start. And we should involve the traditional authority. Individuals with leaking pipes need to fix those

- We must get a better sense of who the new people are and how many
- And we want to remove those not contributing.
- Generally, the idea of the permanent valves at the offtake basin is a good idea. But I think each valve should have a T-piece with 5 pipes linked in so that the pipes are there permanently and people do not need to go and link their pipes to the valve every time
- We should start with the two big leaks first
- Regarding people who don't contribute to maintenance. We cannot forget this is a community thing, so we need to work on ways that the committee can enforce – it's not as easy as removing pipes for those who did not contribute.
- The committee has to earned the power as yet. The Traditional authority says it's a communal thing. It still has to be requested that it is managed by the water committee and only those who pay have access to the pipes
- Neville; if the committee is trusted by the community, you get the mandate form them rather than the TA
- MDF contribution: Engineer's time for 3-4 days and we can match the community contribution
- Contribution in money rather than cement makes sense
- Still worry that section 2 above the road is not included. MDF; It is not – this is a separate area with a different water source, different issues and will need to be tackled separately.
- Presently those who do not have water through the furrow still have hope to be included. It DOES mean that they will have to buy pipes, but they feel that they have permission to sue the water as it stands now

PRIORITIZED ACTION PLAN
1. Those with pipes should contribute to maintenance (not just new people)
2. Pipes should have taps, so not run all the time to save water
3. We need to get more water to be able to provide access to new people
4. Fix leakages in existing pipes

5.1.3.5.6 COMMUNITY HOMEWORK

- Go to the TA to do a report back – 1st weekend of September. _the plan is now based on recommendations and also talk about how and when to make contributions
- Contribution equivalent to cement is ~R100
- Make a list of potential participants and what they promise to contribute. We are hoping collect around R4 000

5.1.3.5.7 MDF HOMEWORK

- Get Chris to draw up specific options for the leaks
- Lepelle will let us know when they are ready to do something practical. Chris can come back for a few days to assist
- Mango training and fruit tree deliveries Sept-Oct. (Community need to be informed in advance so that they can organise the cash for the trees (R25/tree)

5.1.4 Networking & collaboration

Partnership between Hoedspruit Hub and Mahlathini for customised agroecology training and marketing support for organic produce

Here a workshop was held with the participants (15 in total) who volunteered to be part of the marketing process, in production planning, quality control and the sales process in the beginning of July. Then the marketing process was initiated. It has now been up and running for around 6 weeks, with weekly delivery and sales.

5.1.4.1 Herb growers training workshop (By Nelson- 09 July 2018)

Hoedspruit Hub and Mahlathini facilitated the first training workshop at Sedawa for the herb growers. The workshop included sections for garden layout and mapping, basic planning, planting schedules and record keeping. This will help in knowing how much the participants will have ready for harvesting and how much they will be able to sell.

Participants worked in small groups to do the garden layout and planning exercises and looked also at which records participants would keep to ensure quality of produce and continuity of production

What do you record?

- Water use
- Seeds/seedlings
- How many seeds/seedlings
- Planting and harvesting
- Labour cost

What is important in a garden?

- Soil type and fertility
- Exposure of the sun and shades
- Water source
- Slope
- Pathways in the garden; and
- Space

Figure 11: A small group of participants working on their garden layout drawing

Figure 5: Right; Participants doing their playout and planning exercises and Far right: Moshe presenting his trench bed layout process for herb production.

5.1.4.2 Preparing for HH herb marketing process

The training workshop was followed by a preparation session, where Sylvester and Betty worked with the group to cut, was, weigh and prepare their herbs for sale. In this way everyone could be clear regarding the quality requirements. This was on the day of the first delivery, which was undertaken by MDF.

This initial process also helped to iron out some misunderstandings and create the set of rules for delivery.

Figure 6: Right; A trench bed planted to parsley and coriander (Lenah Malepe, ready for harvesting and Far Right; Sylvester working with the group to prepare, wash and weigh the herbs for the first delivery to Hoedspruit Hub.

5.1.4.3 Summary of progress of the marketing process

Mahlathini and Hoedspruit hub are working together to assist small holder farmers in the Lower Olifants, to market of their freshly produced organic vegetables and herbs to restaurants and shops in Hoedspruit. Small holder farmers are excited about this opportunity and they want to keep it going. We collect lists of available produce from the farmers on Mondays and send that to Hoedspruit Hub who arrange the orders for the week with the clients/ buyers. Delivery is made by the farmers to Hoedspruit Hub on Friday and then they deliver the orders to the clients. The sales are for produce both from the smallholder farmers and from Hoedspruit Hub itself.
Below is a summary of sales to date.

Table 7: Delivery and pricing for produce sold between 17 August and 17 September 2018.

Date	Herbs	No bundles	Price	Amount	Total
2018/08/17	Basil	2	R15,00	R30,00	
	Coriander	32	R14,00	R448,00	
	Flat leaf parsley	21	R9,50	R199,50	**R677,50**
2018/08/24	Coriander	20	R14,00	R280,00	
	Flat leaf parsley	20	R9,50	R190,00	
	Spinach	30	R10,00	R300,00	
	Onions	33	R10,00	R330,00	**R1 100,00**
2018/08/31	Coriander	30	R14,00	R420,00	
	Flat leaf parsley	15	R9,50	R142,50	
	Basil	4	R15,00	R60,00	
	Spinach	24	R10,00	R240,00	**R862,50**
2018/09/07	Coriander	10	R20,00	R200,00	

	Parsley flat leaf	10	R20,00	R200,00	
	Parsley curly leaf	2	R20,00	R40,00	
	Funnel	6	R20,00	R120,00	
	Cabbage	7	R20,00	R140,00	
	Basil	4	R20,00	R80,00	
	Beetroot	2	R15,00	R30,00	
	Tomatoes	13	R10,00	R130,00	
	Spinach	40	R18,00	R720,00	**R1 660,00**
2018/09/14	Coriander	10	R20,00	R200,00	
	Parsley flat-leaf	10	R20,00	R200,00	
	Parsley curly-leaf	20	R20,00	R400,00	
	Cabbage	4	R20,00	R80,00	
	Basil	4	R20,00	R80,00	
	Beetroot	20	R15,00	R300,00	
	spinach	27	R18,00	R486,00	
	Onions	25	R10,00	R250,00	
	Fennel	4	R20,00	R80,00	**R2 076,00**
Total sales					**R6 376,00**

A total of R6 376,00 has been made by the smallholder farmers in this first month. This is very impressive and amounts to around R600 per smallholder farmer earned for this month for the average of 10 farmers involved.
Issues of continuity of production may as yet mean that these high figures can not be maintained every month, but thus far the process is working well.
For the first order, we only delivered herbs, as we did not yet know whether there was a market for the vegetables. Farmers came together to work on the first orders, learning how to wash, weigh and pack herbs, so that they could continue with that process into the future by themselves. We also worked on quality of the herbs and vegetables, which is very important for the market.

Figure 7: First week of sales; learning about washing, weighing, packing and herb quality.

For the second week, some vegetable orders were included (spinach and onions). We accompanied Nelson to do deliveries of orders in Hoedspruit. He was introducing Christina to the clients. We made the first stop at Fig & Bin and they were very happy to see such high-quality vegetables. They ordered spinach and onions. Initially there was a very large quantity of coriander, as this is a herb we focussed on believing it would sell. It was however very difficult for Hoedspruit Hub to find buyers for all the coriander. They went to large amounts of effort to make pesto and dry the herbs and undertook to sell these at the Saturday markets in Hoedspruit. It is however too time consuming to continue with this process in an ongoing way.

Figure 8: Pictures for the 2nd week of delivery of produce

For the 3rd week, it was Magdalena Malephe's turn to accompany Betty and Nelson to town to meet the buyers/clients. We made our third delivery the following Friday the31st August 2018.

Figure 9: Right: Packing and sorting the orders at Hoedspruit Hub and Nelson doing the delivery at the Fig &Bin.

Setting of prices for the herbs has been a bit of an ongoing process. MDF had suggested one price set for the entire season, but Hoedspruit Hub have been working more closely with actual prices attainable. This means that prices have changed, generally for the better for farmers. Also, for example the basil supplied by farmers was much more per packet than is generally sold in the stores such as PnP. Thus, they were advised to split their bundles. Farmers, of course were happy to earn more. They may however not be so happy when prices drop again, but it is considered good experience for them to understand that the market fluctuates.
The fifth delivery was on the 14th of September. Checking of quality is made once it is delivered at the Hoedspruit Hub, by Nelson, Betty and Christina. She is the coordinator at village level; farmers bring their washed and packed herbs to her (Sedawa, Botshableo and Turkey). She travels by taxi to Hoedspruit hub to deliver the produce to Nelson, who inspects and counts it and then pays cash for the produce. MDF generates in invoice for those payments at that time. Christina then distributes the monies to each farmer on her return home. This system is working well at the moment, although we are aware that there is not enough of a paper trail. Each farmer is not aware of what they will receive until they are given the cash and this

means that opportunities for money going missing are being created. At the moment we are working on a system of management and control that would be appropriate.

Figure 10: Pictures of the sorting and making of orders at Hoedspruit Hub prior to delivery to clients

5.2 Success and Challenges in meeting milestone.

Lack of water for agricultural activities continues to be a major problem, despite efforts to work within RWH and water conservation and the community level attempts to access new sources of water. More and more participants now only have access to household water, bought from neighbours. It is not financially viable for them to use this water for production. Thus, many of the poorer community members are now not actively farming. For the most part participating smallholders are now focussing exclusively on small scale vegetable production.

Attempts at re-initiating activities in the Oaks and Willows were not successful and in both cases learning workshops organised around cropping calendars and seed saving were unattended. They have also not responded to invitations to join the review workshops, cross visits or training offered through Hoedspruit Hub. In Fenale, the practice of having meetings on Saturdays has been re-instated and attendance there is regular, albeit a small group of participants (6-9)

Participation in the other 5 villages is good and new members are brought on board on a reasonably continuous basis.

5.3 Monitoring and evaluation

5.3.1 Garden monitoring (July-September 2018)

Garden monitoring is conducted on an ongoing basis, now using an e-survey loaded on Pendragon. A point is made to include different participants for every milestone cycle. Originally the idea was to do the monitoring for each participant at least once per season (3-4 months) to be able to track how individuals progress throughout the project cycle. This level of monitoring is however too intensive. Monitoring is now done to ensure a good spread of participants across the villages, so ensure that all present participants are monitored.

For the period of July-September 2018, 29 garden monitoring forms have been filled in by the intern, Betty Maimela, with assistance from the Local Facilitator for Sedawa, Christina Thobejane. Monitoring has been conducted for the following villages: Sedawa, Mametja A, Botshabelo, Turkey and Lorraine (Sekororo). Lorraine is a village where MDF worked in partnership with Lima-RDF to introduce tunnels (4 participants) and farmer experimentation. This collaboration was started in the 2017-2018 project period, but has not continued, due to staff and project changes within Lima. We conducted the monitoring to check progress for these participants in the last year and to provide some closure for this activity.

The two graphs below indicate the implementation for the participants monitored during this period.

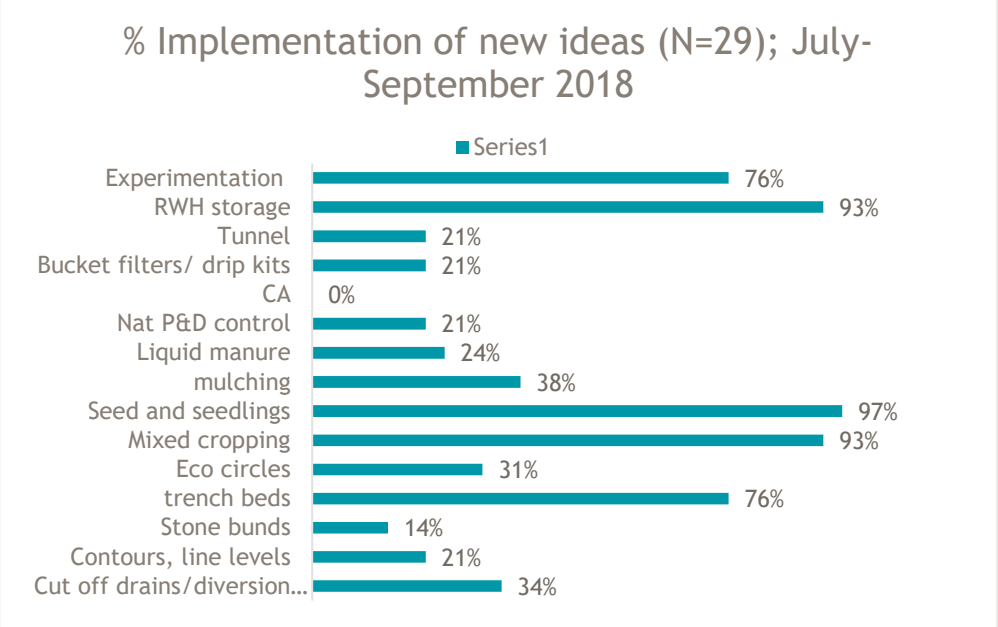


Figure 11: Percentage implementation of new interventions and new innovations for a selection of participants from 'Active" villages; July-September 2018

From Figure 12 above, the implementation of new interventions is high for vegetable production practices; including for example keeping seed, growing seedlings from seed, mixed cropping, trench beds and RWH storage. It is clear that these participants are active in gardening and focussing on activities that can maximise their production. Practices related to soil and water conservation show much less enthusiastic uptake.

Farmer experimentation shows a high level of uptake (76%). The small table below shows the experiments undertaken by these participants. In all cases participants have experimented with different bed designs that could maximise production and efficient use of scarce water resources. Trench beds are by far the most popular option. Here participants have made an average of 3 trench beds each for the 21 participants where monitoring was conducted. A few participants now have as many as 10 trench beds, indicating their level of commitment to this practice.

Farmer Experimentation	No of participants (N=29)
trench beds	21

tower gardens	4
banana basins	3
Eco-circles	5

Implementation of natural pest and disease control has lagged behind a bit. Participants use ash, aloes and liquid manure, but not the brews suggested in the learning sessions. They do however practice mixed cropping. Most participants stated here that they have not had pest problems ad have thus not needed to try out the options introduced. In addition, they prefer to use what they have at hand, rather than having to buy or acquire the ingredients for the recipes (e.g. soap, paraffin, chillies and garlic).

Use of greywater is also not as common as would be expected. Participants still believe that they cannot use greywater on crops and have not taken on the use of tower gardens and bucket filters for themselves. The participants who use greywater (55% - see Figure 13 below), use ash to clean the water and prefer to use this water on perennial plants and fruit trees. It is becoming apparent that innovations that require 'outside' resources, such as shade cloth, buckets, gravel etc are not being implemented by the participants.

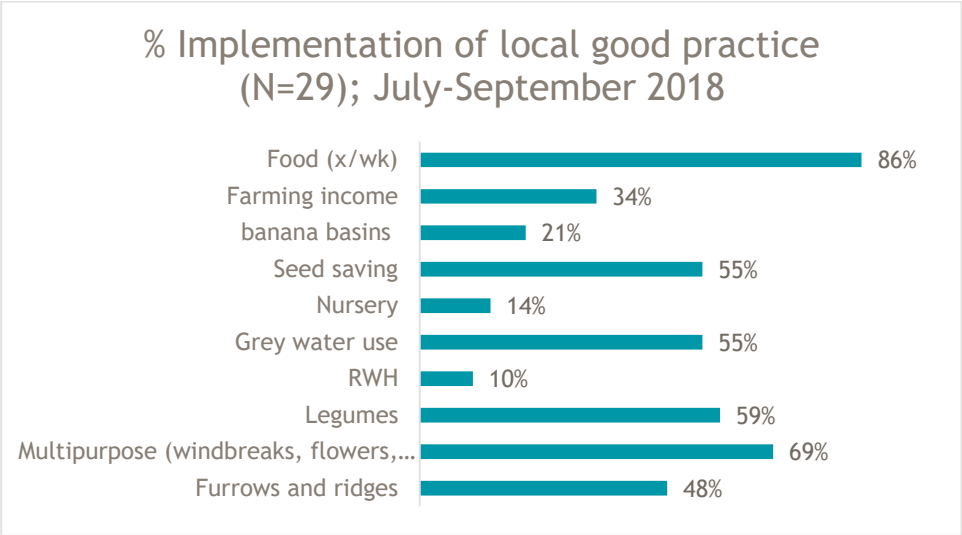


Figure 12: Percentage implementation of local good practices for a selection of participants from active villages; July-September 2018

From Figure 13 it is clear that the primary intention of vegetable production is for household food supply. Participants grow a wide range of crops and vegetables including: sweet potatoes, carrots, beetroot, cabbage, tomatoes, green peppers, green beans and onions. In addition, 52% of participants are now harvesting, eating and selling "new" vegetable varieties introduced through the AgriSI, including kale, mustard spinach, lettuce and spring onions. On average 2,3 different types of vegetable are eaten 1,4 times/week. This indicator gives an impression of food security, which includes an indication of diversity of food produced as well as continuity of food production. For the latter, participants are still struggling a bit with continuity, producing crops in batches and not all the time. This indictor would ideally be around 3 vegetable types eaten 3x/week.

In terms of farming incomes, 405 of these participants are selling surplus from their gardens, making on average R237,50/month. They sell locally and crops sold include tomatoes, onions, spinach and mustard spinach. These incomes do not as yet include the herb sales through the Hoedspruit Hub initiative, which has been reported upon separately, (14 of the 29 participants interviewed here are growing herbs) (Section 4.2.5 above) Two of the participants have businesses selling vegetables, selling crates of avocadoes, tomatoes, as well as bunches of spinach and Chinese cabbage. These participants produce in larger fields. They make on average R3 300-R4 000 per month from their produce sales.

The percentage of participants saving seed is around 55%. This is significantly higher than the percentage of participants who saved seed in the corresponding period last year, which was around 25%, for the 38 participants for whom monitoring was done in July-August 2017. This could potentially be due to the renewed focus and interest in seed saving as a result of the seed saving workshops and trainings that have been conducted in these villages.

Below are a few case studies for selected participants.

5.3.1.1 Case study: Matibela Moradiya (Sedawa)

Matibela is an active participant who has tried out most of the new interventions and innovations introduced in the learning sessions. She has experimented with trench beds, eco-circles, mixed cropping, seeds and seedlings, mulching and liquid manure. She also has a tunnel and drip kits. Like many other participants she is really struggling with water supply and is purchasing water in 210l drums for irrigating her garden. This has meant that she has focussed almost exclusively on her tunnel. She manages to eat 1-2x/week from her tunnel and also sells small quantities of surplus vegetables and herbs.

Figure 13: Clockwise from top Left: Matibela's tunnel; with spinach and peas visible; her yard which is now almost entirely devoid of other crops due to drought; a bed of carrots in her tunnel; and the drip kit irrigating a bed of spring onions and parsley in the tunnel.

The most significant innovation for Matibela, is that she has tried to extend her tunnel.

Figure 14: Matibela's tunnel extension.

5.3.1.2 Case study: Eco-circles

Eco-circles are small double dug beds containing manure and organic matter (grass and weeds) and also is provided with a 2litre bottle sunk into the bed itself to provide slow below ground irrigation. The bed is designed as a circle with a width that will allow full irrigation of the bed from the bottle. So, it is a process of intensification of production, linked to efficient use of water. This bed type is really used as a learning tool and participants are encouraged to experiment with the design and layout to suite their needs.

Below are 3 examples of eco-circles as implemented by project participants

Figure 15: Above left; Josephina Malepe's eco-circle (Sedawa)- she has used cut grass as mulch. Above right; Makgalangakhe Mohale's (Turkey 2) eco-circle. She has made a sunken bed here and integrated it with another bed and a furrow and ridge. She has used leaves as mulch.

Figure 16: Right and far right; Phelecia Shaai's 9Turkey 1) eco-circle. She has also used an adaption of sunken beds and has included the eco-circle in her overall garden design. On the far right are her trench beds (not planted yet)

5.3.1.3 Sekororo (Lorraine) case study

Sekororo (Lorraine), the joint implementation site with Lima -RDF, has four participants experimenting with tunnels and a number of other gardening practices of the four participants, three have borehole water in their yards. Below are some pictures for two of the participants.

*Figure 17: Lydia Setshebu's tunnel. She has four *4.5m trench beds (3 in her tunnel and one outside) where she planted spinach, beetroot, kale and tomatoes.*

Figure 18: Left; Tree leavers and vegetation collected for use as mulch and Right; Lydia's traditional furrows and ridges, where she has planted mustard spinach and kale.

Lydia works as a home- based carer in her community. She produces vegetables for household use and sells surplus. She also practices mulching and uses liquid manure to control pests and diseases in her garden. She sells one bundle of spinach for R10.00 and she can sell close to eight bundles a day, making an income of R80.00/day.

Tshwene Maebelo is the local facilitator in the community. He doesn't have borehole water, but uses grey water and buys water both for household use and gardening. Mr Tshwene has established a poultry house in his yard, early last year and produces broilers for sale to the community. In addition, he is trying out a number of different gardening practices, including a tunnel, tower garden and eco-circle. He uses mulching, mixed cropping and liquid manure, both for fertility and as a pest and disease control measure.

Figure 19: Clockwise rom Top left; Mr Maebelo's poultry house, a tower garden, and eco-circle and his tunnel with three trench beds and drip kits.

5.3.2 Indicators: Assessment October 2018

Figures in the table reflect numbers for the period of reporting, in this case May-July 2018.
A combined team meeting to review this assessment sheet was conducted on 18 June for this reporting period and numbers have further been summarised from field reports and discussions with the field team.

Table 8: Summary of indicators assessments for the duration of the AgriSi project: July- October 2018

Indicator	Overall target	Actual October 2018
No of participants in learning groups	120	105 Sedawa water issues w/s x2 (44), Lepelle water issues workshops x 2 (38), Botshabelo review (11), Herb growers workshop (12)

No of learning groups	6-7	6
No of local facilitators	6	4
Percentage of participants engaged in CC adaptation responses	1-2 (45%) 2-3 (25%) >3 (10-15%)	1-2 (19%) 2-3 (50%) >3 (31%)
No of participants experimenting with new innovations -local -co-designed	 15% 45%	 10% 75%
No of participants showing increased knowledge	35%	-
Percentage of participants engaged in collaborative activities	35%	44%
Percentage of participants with improved livelihoods -increased availability of food -increased income -increased diversity of activities and livelihoods options	 40% 5% 5%	 -86% -27% -12%
Qualitative assessments; -stakeholder engagement -Increased understanding and agency to act towards achieving increased resilience - Adaptation and innovations into local context -Potential for increased resilience -Social engagement	Stories, case studies (5), CC impact summaries (4), best practices booklet	Garden monitoring (1), eco-circles (1) Lorraine implementation(1), herb growers and sales progress (1)
Stakeholder engagement	MoU with Hoedspruit Hub for sale of herbs and veg from 2 learning groups and mango production training, as well as support for purchase of fruit trees Agro-ecology network	

5.3.3 Project Life Change Questions:

1. *Do we have examples or stories of how we or others are in the process of adaptive management related to CC? (adapt, reflect and respond to….) and examples of what this adaptive management is?*

The gardeners active in the villages of Sedawa, turkey, Botshabelo and MametjaA have all adapted the practices introduced to suite their present conditions of severe restrictions related to water. Some have planted in the tunnels only, using mulch to further reduce water loss, other have used trench beds which hold water better than the traditional furrows and ridges and a few have used eco-circles- as small intensive beds, still possible to maintain with very little water.

2. *Do we have stories that show innovation or lack of innovation towards positive change? What insights have we gained into how innovation can lead to positive change? (INCREASED RESILIENCE)*

In turkey in particular, participants have realised the value of microclimate management and are trying various ways to provide shade and cover for their crops. Because grass is scarce as a source of mulch, people have now used the leaves fallen from trees, that have been swept up in their yards as mulch.

3. *Do we have stories that show evidence of, or an interest in self organisation towards collective action? What insights have we gained into how self-organisation can lead to collective action?*

The work with the two water committees (Lepelle and sedawa) is now ongoing in support of their vision and actions for provision of agricultural water for themselves. In turkey, community members are a bit further along with this process and have divided themselves into groups of roughly 10 households which work together to procure a source in the mountains and bring a pipe closer to their homesteads; which they share.

Participants in Sedawa in particular are very keen to use their community video shot through the participatory video process to lobby the stakeholders in the area. They want to "go all the way to the top" as they believe their local officials are too corrupt to respond to their requests and needs.
Participants in Sedawa have also specifically spoken to the Botshabelo farther and son team who have et up a local water scheme in that village to glean advice and learnings from them for this process.

4. *Do we have stories to show that learning together is happening or that there is an interest in learning together? What insights have we gained about how to learn together?*

Further sharing has happened in this period around the building of tunnels, which some groups have mastered better than others and also around the production and packaging of herbs and vegetables for sale to shops and restaurants in Hoedspruit

5.3.4 Work Plan for next period (10 October- 15 December 2018).

1. Garden monitoring to be focussed on:
    - A comparison of participants with and without tunnels (20 of each), as a case study to quantify the impact of tunnels on production
    - Lepelle, Finale, The Oaks and Willows, to assess implementation of new ideas and innovations by participants from these villages. Participation from these groups has been limited in the 2018-2019 project period,
2. Re-introduction of Natural Pest and disease control options; including growing of pest repellent plants and crops
3. Re-introduction of greywater management; different options, including use of moringa seed for cleaning water prior to use.
4. Continuation with water committees and water provision projects in Sedawa and Lepelle – to include a borehole survey in Sedawa, further workshops for planning and collection of contributions form participants, writing of funding proposals by MDF to source co-funding.
5. Learning session in Organic Mango production and supply of subsidised fruit trees in Lepelle.
6. Continuation of herb and vegetable production for sale through the Hoedspruit Hub partnership process. The next round of seedlings was supplied towards the end of September and participants are also growing crops from seed.
7. Learning sessions; review of S&WC and CSA, for all groups (1 day), Start on Poultry production training in Botshabelo, Turkey, Sedawa).
8. Cluster network session; Impacts of activities
9. Agroecology network- sessions on a CoP for best practices in CSA
10. Use of participatory video as a tool to build agency in the villages for CCA activities and communicate successes and issues with relevant stakeholders

6 Overall Progress of Project

6.1 Integration of milestone status.

The table below indicates overall completion of activities according to milestones.

Table 9: Milestone target completion July-October 2018

MAHLATHINI	MILESTONE COMPLETION: Completion to date % (in black)						
Key activities / Milestones	MILESTONE 1	MILESTONE 2	MILESTONE 3	MILESTONE 4	MILESTONE 5	MILESTONE 6	MILESTONE 7
Inception report	100% /						
Setting the scene		50%					
New villages, baselines, visioning scenarios		Turkey, CCA workshops, visioning and baseline			New village, CCA workshops, visioning and baseline		
Learning and mentoring		25%	4%				
Learning sessions x 3-5 for ea learning group, value adding activities, mentoring LFs (24 sessions total)		Turkey (3 sessions) Sedawa, Botshabelo, Lepelle (3 sessions)	Botshabelo (1 session); Sessions for willows and The Oaks cancelled due to lack of attendance				
Experimentation & intro to innovations		20%	20%				
Individual experimentation New innovations -seed saving, fodder production etc		2 villages (Turkey, Sedawa)	4 villages Turkey, Sedawa, Botshabloe, MametjaA (tunnels, drip kits, trench beds, herb growing, greywater)	6 villages	6 villages	6 villages	6 villages
Collaborative work		20%	20%				
Joint experimentation on new ideas Collective action RWH, erosion control activities		3 villages (Turkey, Sedawa, Lepelle)	3 villages (Turkey, Sedawa, Lepelle)				
Networking and cross visits		15%	15%				
Community level cross visits Stakeholder engagement		-Agroecology network -Hoedspruit hub	-Hoedspruit hub (herb growers- visits to buyers)				

6.2 Project risk and mitigation summary.

6.2.1 Implementation risks and mitigation

Implementation is proceeding well at this stage, with no further risks identified.

6.2.2 Financial risks and mitigation

The project is on track and is being managed within the budget confines set out.

6.3 Project work not directly linked to the milestone

6.3.1 Quantitative measurements

This small research process is co-funded through a contribution from the Water Research Commission. Results are presented here, as they augment our explorations of impact of the different CSA practices in terms of water productivity and cost-benefit analyses.

For the individual experimentation cycle of November 2017- April 2018, a number of quantitative measurements were undertaken. The table below provides a summary.

Table 10: Participants in quantitative measurements for trials; Limpopo: September 2018

Province	Category	Name of participants	Name of village	Measurements undertaken
Limpopo,	Field cropping and gardening	Christina Tobejane	Sedawa	Weather station; rainfall, air temperature, solar radiation, wind speed, wind direction, relative humidity) Rain gauges; 4 in Limpopo
Limpopo	Field cropping (CA)	Koko Maphori	Sedawa	Run-off plots, bulk density, gravimetric soil samples,
		Lerato Lewele	Mametja	
		Seemole Malepe	Botshabelo	
	Gardening (Tunnels, drip kits – trench beds, mixed cropping, mulching)	Christina Tobejane	Sedawa	Chameleon sensors
		Norah Malepe	Mametja	
		Mariam Malepe	Botshabelo	

6.3.1.1 Limpopo measurements for individual experimentation

*Written by Sylvester Selala (*Note: Mr Selala is intending to register for a PhD in Bio resources Management, but wanted to do this first round of implementation to gauge the overall potential of this topic)

6.3.1.1.1 Outline of the process

Most smallholder farmers are aware that current farming practices are no longer producing expected yields. In the light of extreme temperatures and low and erratic rainfall (associated with climate change), farmers are desperate to try anything which looks like it might have potential to improve their productivity. It is part of national policy priority to promote sustainable farming practices in smallholder farming communities, and such practices include climate smart agriculture practices (CSA). Learning around new practices occurs through workshops, mentoring and farmer experimentation. How farmers prioritize implementation of new technologies has always been a question, especially if they are introduced to several technologies at the same time. Some of the criteria found in literature that famers use in prioritizing farming practices include, ease of implementation and perceived benefits. We have learnt through our engagement with the farmers that introduced practices and their experimentation have to give immediate positive effects (in the first season of implementation) for them to be interested to continue with those practices. While this makes sense, it also complicates the introduction of practices (such as Conservation Agriculture for example) that could take longer to show positive results

Even though smallholder farmers are interested in practices which will give them good yields, they generally do not have a good understanding of their yields in relation to actual yield potential or the size of the areas they have planted.

The purpose of introducing quantitative measurements in this setup is; firstly to develop benchmarks around a range of indicators (including yield, soil fertility and soil health _microbial activity, organic matter, carbon), run-off, infiltration, bulk density, water holding capacity and water productivity), and secondly to works with farmers to develop set of visual indicators for prioritizing CSA practices. The latter would allow farmers to make decisions about adjustments they can make to the practices to best suit their situation or condition.

Some of the questions asked by farmers could be answered through these more intensive measurement processes. These questions include for example;

- How many trench beds are required to make a profit on vegetable sales,
- Which crops/ varieties will give higher yields,
- What is the return on investment if buying the tunnels (shade house structures);
- How to reduce stress and wilting in crops;
- And the amount of water needed to run a garden throughout the season.

We as the researchers also included some indicators we thought would be useful for comparing scientific derived indicators with locally derived indicators. This would assist in assessing the impact of these practices in the particular localities they have been introduced in.

6.3.1.2 Methodology

Farmers were introduced to a wide range of CSA practices, but they have chosen to carry on with certain practices and never tried others. They have praised the practices they have carried on with as producing good crops of good quality, saving water and working better than the traditional practices. In trying to understand how farmers arrived at the decision of prioritizing certain practices over others we setup experiment to test their theories around the practices. Deep trench beds, conservation agriculture and tunnels are the most favoured practices.

For each of them we looked at, water productivity, evaluated whether the practices improve soil fertility or soil health and evaluated how farmers have received working with measurements (use of rain gauges, weather stations, runoff plots and chameleon sensors).

For water productivity (WP), the experiments were aimed at comparing water productivity of different systems (e.g. comparing water productivity of conservation agriculture to that of conventional tillage). With regards to gardening, the experiments were aimed at comparing the WP of trench beds that are inside a tunnel, trench beds outside tunnel and the traditional way farmers use to grow vegetables.

Three sites were selected and were situated in Botshabelo, Sedawa and Mametja. The idea is to use these three sites as parent sites and establish mini experiments with other farmers in the learning groups.

6.3.1.3 Background on water productivity

With extreme temperatures reaching and average of 37°C in the summer season and average seasonal rainfall of less than 200 mm (now concentrated in a few months) growing anything without supplementary irrigation is almost impossible in the area. Possible sources of water for irrigation include, municipal water (water from boreholes), streams, wells (natural springs) and rooftop rainwater harvesting and more recently, yard or surface rainwater harvesting. Although some of these sources are drying out, the most feasible option for farmers as far as water is concerned is managing the limited water they have as best they can. In realizing that options for increasing water supply (e.g. building dams, underground rainwater harvesting tanks and drilling boreholes) are limited we opted to focus initially on management of available water, especially in the homesteads.
In field cropping systems, the focus has been on dryland cropping, given that sources of water such as streams are situated far from the fields and cost of conveying water into the fields are very high. Those with fields in proximity to a stream do not have water licenses or permits to abstract water from the streams (river).

We set up and experiments to evaluate water productivity of both gardening and field cropping systems. In field cropping systems we measured the following parameters; rainfall, runoff and weather station information (air temperature, solar radiation, wind speed, wind direction, relative humidity).
Farmers are unfamiliar with some of the techniques used to gather information (e.g. rainfall data, runoff and soil fertility). We introduced farmers to some to these techniques and explained what the data can be used for and how taking measurement could contribute to the decisions making process regarding what to plant and when and how much. Most importantly the techniques were introduced for purposes of ensuring that farmers explore them and see if they can be of use to them. Building capacity around scientific data collecting and how it fits into farming was central to this process.

We worked with the farmers in setting up the instruments for measuring parameters. Local facilitators were tasked with collecting rainfall, runoff and chameleon sensor data. Four standard rain gauges were installed in 2 villages, Botshabelo, Mametja and 2 in Sedawa.

Right and far right: Installation of rain gauges and explaining the process for reading and recording rainfall events.

Record keeping of rainfall was done reasonably well by all four participants selected and are presented in the table below.

Table 11: Rainfall records from 4 standard rain gauges in Sedawa, Mametja and Botshableo

	Sedawa		Mametja	Botshabelo
	Christina Tobejane	***Koko Maphori***	***Lerato Lewele***	***Mariam Malephe***

Date	rainfall (mm)	rainfall (mm)	rainfall (mm)	rainfall (mm)
21/12/2017	5	10	8	7
24/12/2017	1	4	3	4
30/12/2017	22	32	30	28
25/01/2018	1.5	3.5	3.8	5
28/01/2018	1.6	2.1	2	3
30/01/2018	1	1.5	1.8	1.4
24/02/2018	2	2.6	2.8	2.4
16/03/2018	28	51	30.2	10.2
21/03/2018	9	20.8	10.2	20.5
24/03/2018	20	32	28	9
01/04/2018	9	8	15	30
02/04/208	1.4	2	2	1.8
Total	**101.5**	**169.5**	**136.8**	**122.3**
Ave for each rainfall event	8.5	14.1	11.4	10.2

It is interesting to note the variability in records between the 4 rain gauges from the table above. Readings from the two rain gauges in Sedawa are expected to be quite similar; which they are not. This points towards some inaccuracies in record keeping on one of the participants. The slightly higher rainfall values for Mametja and Botshabelo are not significant and do not indicate an overall difference in rainfall in these villages. It is clear that the amount of rainfall in this area has been extremely low for this season.

Although the intention has been to compare these results with the rainfall data from the weather station, ongoing calibration and charging problems with the weather station meant that data was only available from April onwards.

Rainfall records from the weather station (Based at Christina Tobejane's homestead for early April of 8,9 mm between 01-03 April 2018, compare well with those taken from the rain gauge - 10,4 mm.

In determining the water productivity, parameters (temperature, relative humanity, solar radiation, wind speed, wind direction to calculated ET_0) are required and these parameters are gathered from automatic weather stations. This information can be used to benchmark simpler methods used in the field, that farmers can be involved in.

Water productivity in rainfed field cropping systems
Water productivity (WP) is a measure of the output of a given system in relation to the water it consumes. It is expressed by the equation bellow:

$$WP = \frac{Agricutural\ benefit}{water\ use} \quad (1)$$

Agricultural benefit is the grain or crop yield.
In field cropping systems, to simplify the equation used, but include the necessary and monitored indicators, parameters for measuring water use were chosen following the water balance equation

$$P = ET + R + \Delta S$$

Where P is Precipitation, ET is evapotranspiration, R is runoff and ΔS, is change in soil water storage. In this case P represents the water use in the above equation.

Water productivity in gardening systems
In trying to determine water productivity for gardening systems, only the amount of water transpired by the plant is considered. This is because run-off is considered negligible in garden level irrigation practices, as is

change in soil moisture content. For the latter Chameleon sensors have been installed to assist the farmers to understand the available water in their soil and irrigate in a way that ensures good water availability.

In the gardening system, using Equation (1) above, water use then refers to the evapotranspiration only. From ET_0, the actual evapotranspiration is calculated using the equation below, where ETc is the Actual evapotranspiration (mm/day) and Kc is the crop coefficient. If one takes spinach to be the reference crop, as this was planted in the farmer experiments, it is possible to use existing crop coefficients. For spinach this is taken to be 0,95 (According to the FAO, Kc for spinach at maximum height is 0.95).
The actual evapotranspiration is then substituted into the WP equation (1)

$$ET_c = K_c \times ET_0 \quad (2)$$

Where ETc is the actual evapotranspiration, Kc is the crop coefficient and ET_0 is the reference evapotranspiration.

These "simpler" equations were used for calculation of the WP for the field cropping (CA) and gardening (tunnels, trench beds) experiments. The results are discussed in the two small sections below.

6.3.1.4 Gardening systems

To recap, the farmer led experiment for gardening involves planting spinach;
In a trench bed inside a tunnel (shade house structure)
In a trench bed outside the tunnel
In a traditional bed (ridges and furrows) outside the tunnel
There are a number of aims for this experiment:

1. To help farmers make informed decisions about which CSA practices are best suited to their locality and conditions
2. To help farmer develop visual indicators for evaluation of CSA options
3. to assess if and to what extent CSA practices contribute to increased productivity and household income generation and
4. To assess whether traditional practices are still fully functional under varying weather conditions or in the light of climate change

Water productivity, changes in soil fertility (plant essential nutrients, N, P, K) and soil health are the main indicators used for assessing CSA practices. Visual observation from the famers have indicated that some CSA practices, different bed designs (deep trenches, tower garden, eco-circle) increase productivity compared to traditional practices (gardening on ridges). Use of other technologies, for example drip irrigation, and tunnels have also been reported to do better than the traditional system and these observations have been used as the basis for this experimentation process.

We have taken into account the input cost and we are looking at adoption of CSA practices from a cost benefit point of view.

Comparing the farmer method of calculating WP with the "simple" method outlined above
According to the farmers all water applied in garden goes into producing the yield. They argued that because water applied in garden or field cannot be reused for something else, they consider all that water as going to production of yield. Therefore, in determining WP we considered runoff, deep percolation and soil evaporation to be negligible and assumed that water applied becomes transpired by the crop. Therefore, from Equation 2 above, the water use becomes the water applied instead water transpired by the crop.

Farmers kept records of various indicators throughout the growing season. The following information is recorded on the data sheet:

- Amount of water applied (normally farmers use 10 l watering cans to irrigate, therefore the number watering cans applied are recorded)
- Size of irrigation bay or size of bed (in which the spinach was planted)

- Yield produced from the bed (the average weight of the spinach bundles harvested from the same bed is recorded, a kitchen scale is used to weight the spinach) and the number of bundles harvested are also recorded
- Cost of the produce (These bundles of spinach are usually sold for R 10)

Results
The WP calculations were done for the simple scientific and farmer versions of the equation; using actual evapotranspiration and water applied respectively as the water use value.

The small table below outlines the results for those few farmer- led experiments where enough data could be collected.

Table 12: Water productivity calculations for the gardening system farmer led experiments

	Simple scientific method (ET)			Farmers' method (Water applied)		
Name of famer	**water use (m^3)**	**Total weight (kg)**	**WP (kg/m^3)**	**water use (m^3)**	**Total weight (kg)**	**WP (kg/m^3)**
Christina Thobejane (Tunnel; trench beds, with mulch)	0,8	48,9	65	1,10	48,9	56,7
Christina Thobejane (Furrows and ridges with mulch)	0,5	24,5	46,4	3,91	24,5	5
Christina trench outside			-	2,93	14,7*	11,3
Nora Mahlako (Tunnel; trench beds without mulch)	0,8	19,6	26	9,47	19,6	5

*This amount was estimated by Christina as she did not fully harvest this bed, discontinuing it mid-season as it needed too much water, in her estimation

The simple scientific method of estimating water productivity provides for higher values than the water applied method that the farmers prefer. The WP results between the two methods are not directly comparable.

It can be seen that the two methods of calculating WP have provided the following information:

- For Christina; Her WP in her tunnel is obviously much higher than for her traditional planting method of furrows and ridges. Here the trench beds were mulched and she followed a strict regime of deep watering once a week. This indicates a close relationship between the water applied and that used by the plants in the tunnel
- For the furrows and ridges, using the water applied version of calculating WP shows an extremely low WP of $5kg/m^3$ versus the $56,7kg/m^3$ in the tunnel. The production in the tunnel is functionally ten times that of the furrows and ridges.
- For Norah's tunnel the situation is quite different. She did not do mulching and she kept to the 'traditional' watering practice of a little in the morning and a little in the evening every day. She has used a lot more water than her plants have used. This indicates that her practices greatly increase the required amount of water, without increasing the efficiency of use of this water. For these two tunnels the WP calculation (using water applied) is 56,7 kg/m^3 for Christina's tunnel and 5 kg/m^3 for Norah. This is a significant difference in yield brought about by a number of factors;
    - Mulching and deep watering inside the tunnel vs no mulching and repetitive shallow watering
    - Harvesting practises: Another aspect mentioned by farmers when analysing these results is that it is possible that Norah overharvested her spinach, with the outcome that regrowth and further harvesting was reduced.
    - Farmers also mentioned that there is generally more shade from trees, in Christina's garden, even her tunnel is provided with some shade during the day, while Norah's tunnel has no shade.

- Different planting times: This could in fact have played a large part in the WP differences in the two tunnels as Norah planted at the end of February (when it was very hot) and Christina planted at the beginning of April (when it was much cooler)

These results clearly indicate the productive advantage of using tunnels in these hot, dry conditions and further show the added yield and water productivity advantages of mulching and deep watering as crop management practices. Attention will also need to be given to harvesting practices to ensure maximum growth of the spinach.

It is interesting to compare the farmers version of WP to that using evapotranspiration. When one looks at WP in relation to water added, it gives a much clearer picture of how much production is possible with how much water and how the different practices affect this. In this context it can thus be considered a good proxy or visual indicator for water productivity. More farmer led experiments will be conducted comparing these WP indicators.

Generally, it is expected that the WP from the same practices (e,g trench beds in tunnels) should have less variability, but the results have shown otherwise. In a farmers' experimentation setup, some extra variables are often introduced during the process and are sometimes unavoidable. For results to be comparable attention needs to be given to those variables. It is a scientifically frustrating process, but one that provides for ample learning opportunities in such an adaptive research process such as this.

A cost benefit analysis of WP
In these villages farmers pay for their water; either for transport of 210l drums to their homes (bought from local people with boreholes) or for pumping the water from their own boreholes. Presently municipal supply of water is too little to use for gardening and all surface sources have dried up in the last few drought years. Farmer pay R35/201l drum of water

$$Cost\ of\ water\ (per\ liter) = \frac{R35}{210l} = 0.17\ R/l$$

Christina Thobejane planted a 5 m^2 deep trench in a tunnel to spinach and we recorded the amount of water applied and weighed each bundle of spinach she sold. She sold a total of 30 bundles of spinach at R10-00 each and made R300 from this in one season. She applied a total of 1100l of water as irrigation (100 litres per week for 11 weeks). In a deep trench bed of 3.5 m2 in size outside the tunnel she planted spinach and she applied 266 l/ week of water for 11 weeks which makes a total of 2926 litres (13.9 * 210 l) at a cost of R35-00 per litre she would have paid R487.7 for water applied. She was able sell 15 bunches of spinach at R10-00 each making R150-00 for this bed in a season.

	Water	Cost (R/m^2)	Yield	Sales (Rands/ m^2)	Profit (R/m^2)
Trench inside tunnel	1100	R18,70	6 bundles/m^2	R60	R41,30
Trench outside tunnel	2926	R48,80	4,2 bundles/m^2	R42	-R6,80
Furrows and ridges	3913	R130,40	2,4 bundles/m^2	R24	-R106,40

From a water use efficiency point of view, planting on a trench bed without shading requires 2.6 times the amount of water required in a deep trench under shade cloth. The quantities of spinach produced in the tunnel are much higher than those produced outside the tunnel. The cost-benefit analysis above indicates, that if water needs to be bought, it would only be profitable to plant inside the tunnel. The profit is however not very high in this context (~R620/tunnel fully planted (15m^2), for a season). Obviously, if cheaper water can be accessed, this would be a lot more.

She tried the same thing with the traditional gardening system (planting on ridges) but she realized she was using too much water and she then abandoned the bed and focused on the two trench beds.

6.3.1.5 Working with Chameleons

Chameleons measure soil water content, work similarly to tensiometers and provide readings using colour codes (red, green ad blue) for available soil water at three depths in the soil; 20,40 and 60cm. These sensors have been installed at Christina Thobejane (Sedawa), Mariam Malephe (Botshabelo and Norah Mahlaku (Mametja), for their gardening experiments. The intention is to provide the farmers with an irrigation management tool to help them decide when and how much to irrigate. As the readings are uploaded onto the Virtual Irrigation Academy website, they also provide an analytical tool for the research team, as well as real time data on the status to the farmer level experiments.

Irrigation case study: Christina Thobejane
Christina has a small petrol water pump and used to pump water up from the Maphere River (approximately 50m downhill from her homestead) for her gardening activities. That streambed however dried up completely about a year ago. She also has a 5 000l Jo-Jo tank for roof rainwater harvesting and last year was the recipient of a 24000l underground RWH tank. In addition, she used money from her stipend as an LF to have a borehole installed in her yard and she has a pipe linked into the municipal supply system, for the unlikely moments that there is some municipal water supply. She now pumps water from her borehole into her underground RWH tank for use in the garden. She is the only person in her village who is this well organised.

Chameleon sensors were installed in three different beds (trench bed in a tunnel, furrows and ridges outside the tunnel and a trench bed outside the tunnel) to monitor the changes in soil water content. The chameleons were introduced as an irrigation scheduling tool, to her save water.

Christina has made the following comments about the chameleons:

- Applying water until the chameleon changes colour (goes blue) seems to be a good idea as this saves her some water and means that she only has to irrigate once a week (every 7 days).
- She has thus now changed her irrigation practice of watering a little every morning and afternoon, to a deep watering every 5-7 days. Even though this was discussed in the learning workshops, she was not convinced until she managed to work it out for herself.
- The chameleon in the tunnel stays blue (indicating enough water in the soil) for longer than in the other beds.
- She appreciates the ease of using the chameleons – by just checking the colour.

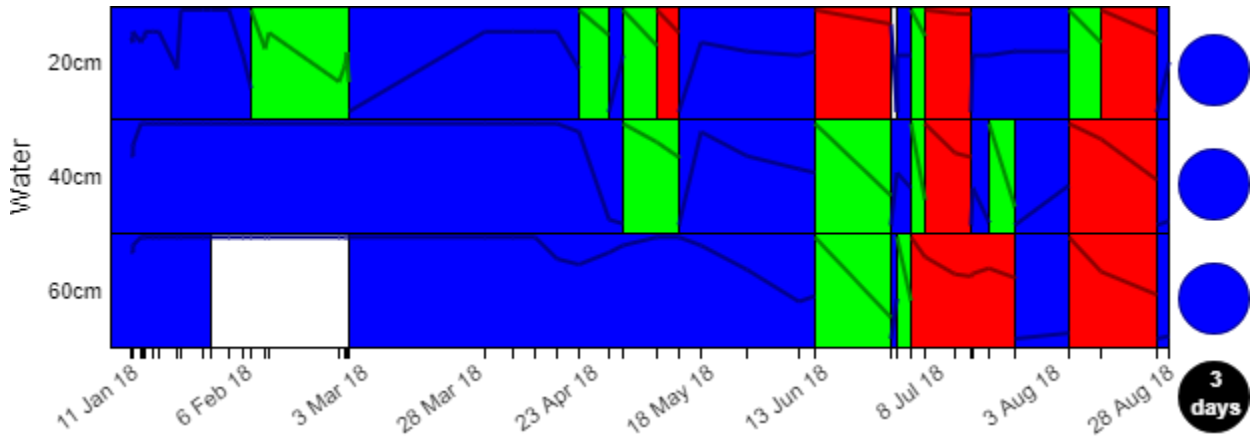
Right: A chameleon reader showing red for all three soil depths (20,40 and 60cm)

Christina managed to harvest the spinach worth R 300 using 1100 litter of water (which she considers to be little water). From our Water productivity results we observed that her water productivity was higher, at 44,5 kg/m^3, than the commercial water productivity (ave 13 kg/$m^{3)}$ in spinach fields. She praised the spinach planted in a trench bed inside the tunnel, saying it looks good even when she takes too long to irrigate. However, she has said her preferred practice is the tower garden (it gives good quality crops, saves water and saves space) She made the decisions about the tower garden based on her visual observation. This highlights the importance of identifying and developing visual indicator which farmers used to make decision regarding practices.

Christina felt that all the weighing and recording of water applied was time consuming and unnecessary, since she could visually see the difference in the plant. Another difficulty lay in the reading the data from the chameleons as this was often frustrated by small wires coming loose in the chameleon array. Uploading this data was also a bit problematic, given that it requires a sizeable amount of data, along with good cell phone reception. She was supplied with a dedicated smart phone (as hers could not manage the app properly) and dedicated data for this purpose and she also does the readings for the other nearby chameleons.

Right: Spinach growing on Christina's trench beds in the tunnel, Sylvester fixing and testing the chameleon

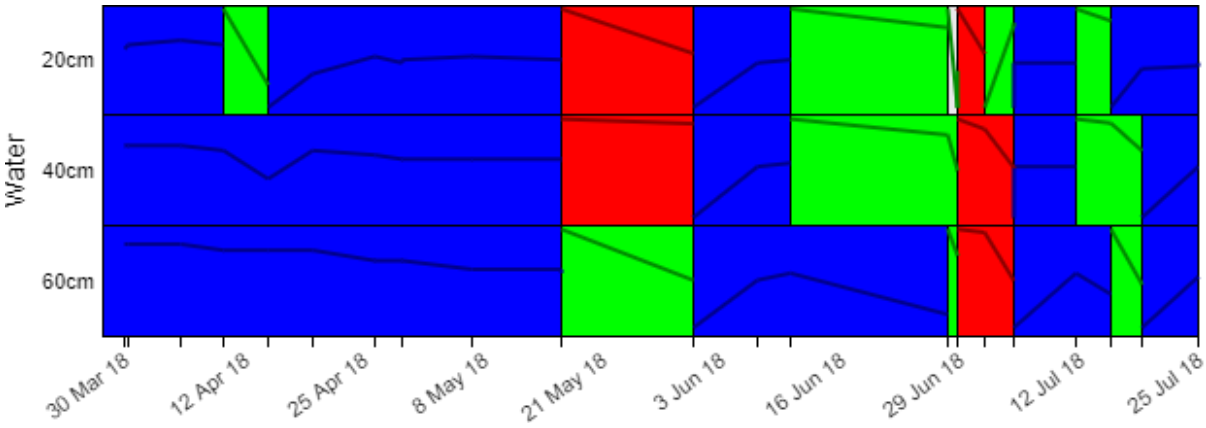
Below are the graphs for the chameleon sensors as uploaded onto the VIA site.



Crop and field management details	
Crop Type	Spinach
First Planting Date (assume continuous cropping)	31 Oct 17
Soil moisture summary	68.0% Blue; 15.0% Green and 17.0% Red
Readings taken	67

Figure 20: Soil water content: Christina's trench bed inside the tunnel (1 September2018)

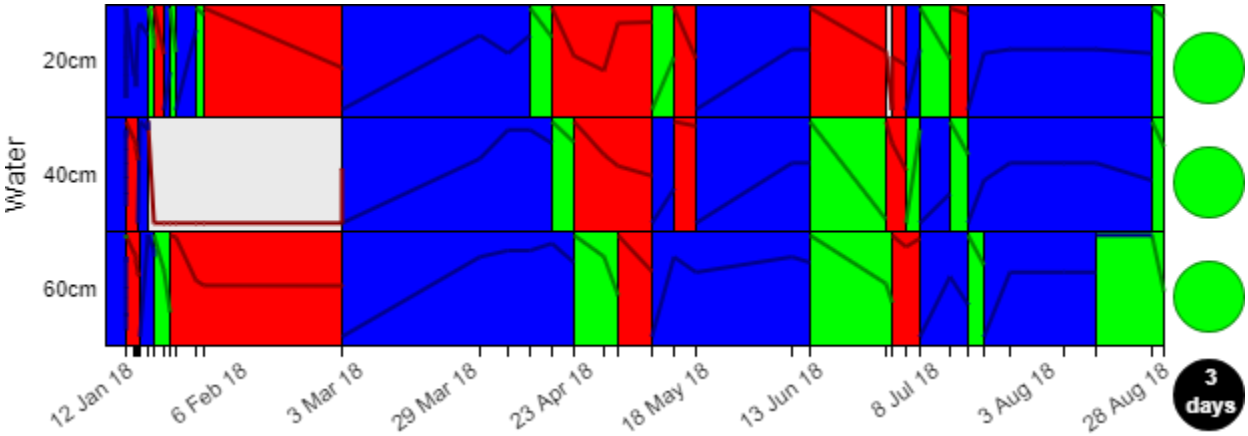
In the last 11 months (since the end of October 2017) Christina has taken readings 67 times- which is a very good average. She has managed to keep her soil moist enough for most of the time. The lines within each soil depth bar show the decrease and increase in soil water content according to the actual readings taken. The increase in green and red chameleon readings toward the ned of the winter season, indicates the overall drying of the soil and potentially an increase in irrigation requirements to ensure good soil water content in all three layers measured.



Crop and field management details	
Crop Type	Spinach
Planting Date	25 Mar 18
Soil moisture summary	67.0% Blue; 19.0% Green and 14.0% Red
Readings taken	33

Figure 21: Soil water content; Christina's furrows-and ridges (traditional beds or control)

This figure above indicates Christina's irrigation scheduling for her traditional bed outside the tunnel. Here she also managed to keep her soil reasonably evenly moist, but she used almost three times more water to do this than in the trench beds.



Crop and field management details	
Crop Type	Spinach
Planting Date	31 Oct 2017
Soil moisture summary	54.0% Blue; 15.0% Green and 31.0% Red
Readings taken	63

Figure 22: Soil water content: Christina's trench bed outside the tunnel

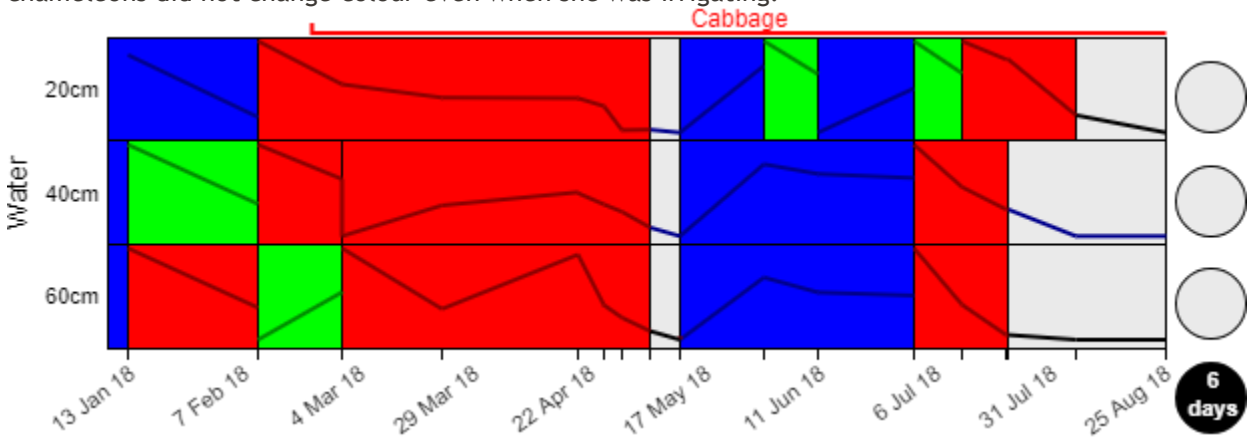
If one compares figure 22 and figure 22, it can be seen that the trench bed outside the tunnel dried out faster than the trench bed inside the tunnel, needing more and more frequent irrigation.

Irrigation Case study: Nora Mahlako
Even though these farmers live in the same area, their water situations are different. Nora Mahlako relies on municipal water supply for household uses as well as gardening. This water supply scheme serves a lot

of people and is overloaded to make provisions for other activities (e.g. farming) on top of water for household consumption. In the time that Nora had planted the municipal water was cut for several weeks and she did not have water for irrigation. She then prioritized the spinach in the tunnel and abandoned the crops growing in the other beds. From the chameleon records below we observed that the soil water content in trench beds and ridges and furrows outside the tunnel was very low.

Nora sees the chameleons as a complicated tool which requires a lot of technical skills from an expert. This was partly because her soil was too dry for the chameleons to detected anything most of the time. Often, we had to go and troubleshoot the problem with her, and this in some ways has made her lose confidence in the tool.

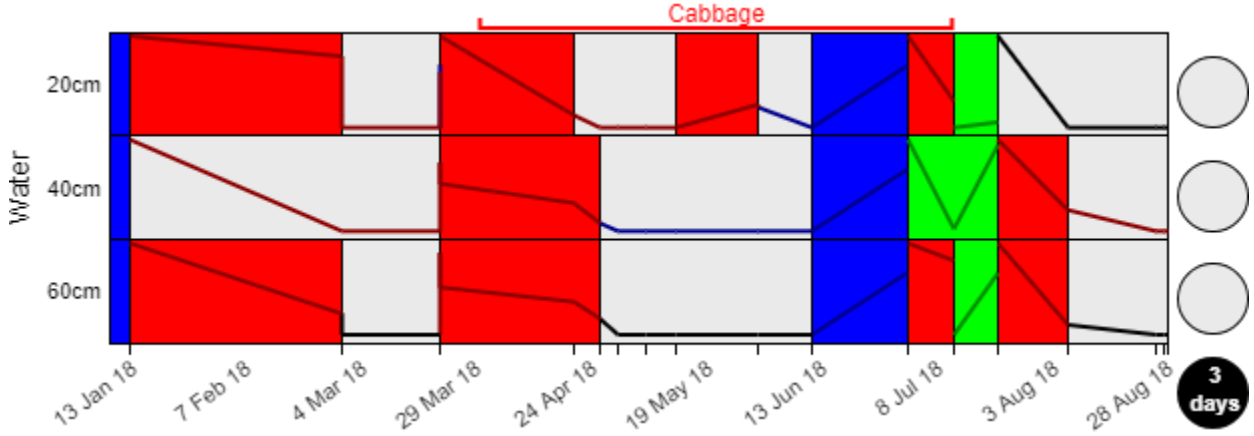
Regarding irrigation, she continued with business as usual (watering small amounts in the mornings and afternoons). We observed for the graphs obtained from the Virtual Irrigation Academy (VIA) website that chameleons did not change colour even when she was irrigating.



Crop and field management details	
Crop Type	Spinach
Planting Date	22 Feb 18
Soil moisture summary	26.0% Blue; 4.0% Green and 70.0% Red
Readings taken	20

Figure 23: Soil Water content; Norah Mahlako -trench bed inside tunnel

For Figure 23, the grey blocks in the Chameleon sensor data indicate soils so dry that readings were not even made.



Crop and field management details	
Crop Type	Spinach
Planting Date	22 Feb 18
Soil moisture summary	29.0% Blue; 0.0% Green and 71.0% Red
Readings taken	10

Figure 24: Soil Water Content; Norah Mahlako- trench bed outside the tunnel

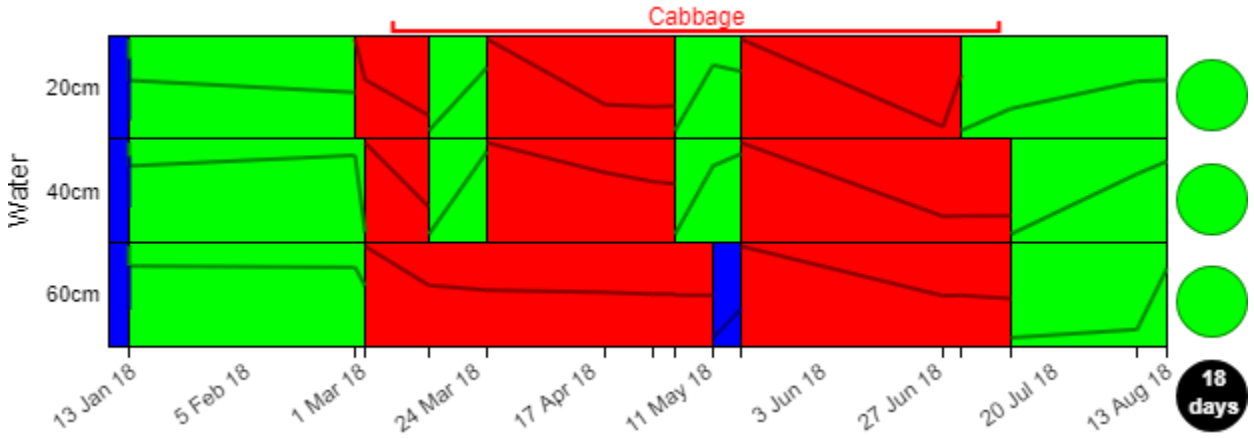
For Figure 24 the situation with overly dry soils is even more severe than in the tunnel.

Irrigation case study: Mariam Malepe of Botshabelo village
Mariam has a Jo-Jo tank in her homestead for roof rainwater harvesting and was also a recipient of an underground RWH tanks. She used to have a pipe trailing down from the hillside (around 3-4km away) from a spring, but this dried up more than a year ago. She also has municipal water supply when that is available. At the moment they fetch water in containers from the Olifant's river, which is about 500 m along the road.

Maraim Malepe tried planting spinach in late February in her experimental beds, but due to lack of water the spinach died. She then planted beans (lazy house wife) in late March, from which she has also not managed to glean any harvests. We thus could not do the WP calculations for this participant. At the in late June she the planted spinach again in the experimental beds which is growing well and she is hoping to get some yield.
Her decision about when to irrigate is based on crops showing signs of wilting, as she feels it takes too much water to change the chameleon readings from red to green (not even blue). She prefers to give a little bit of water to all her crops. It means that she has not managed to benefit much from having the chameleons in her plots, as she would not follow the suggested irrigation practices. It can however be understood, as all the water required at the time had to be carried in buckets.

The effect of growing in the tunnel is clearly demonstrated in her garden where the growth rate for the beans in the tunnel was higher than in other beds, given though she applied roughly the same amount of water to each bed.
Mariam's situation demonstrates that even though observation, monitoring and experimentation tools might have the potential of improving the situation, conditions can be too extreme to abide by recommendations.

Above Left to right:
Maraim's beans planted in a trench bed inside the tunnel, a mulched trench bed outside the tunnel and in furrows and ridges outside the tunnel. Photos were taken on the same day and the difference in growth is visible and obvious.



Crop and field management details	
Crop Type	Beans and later spinach
Planting Date	8 Mar 18
Soil moisture summary	2.0% Blue; 50.0% Green and 48.0% Red
Readings taken	11

Figure 25: Soil water content; Mariam Malephe-trench bed inside the tunnel

From Figure 25, Mariam's decision to irrigate only until the chameleon turns green is quite obvious. One can also see that she was not as fastidious about taking readings as Christina for example, as he only took 11 readings during a 9- month period.

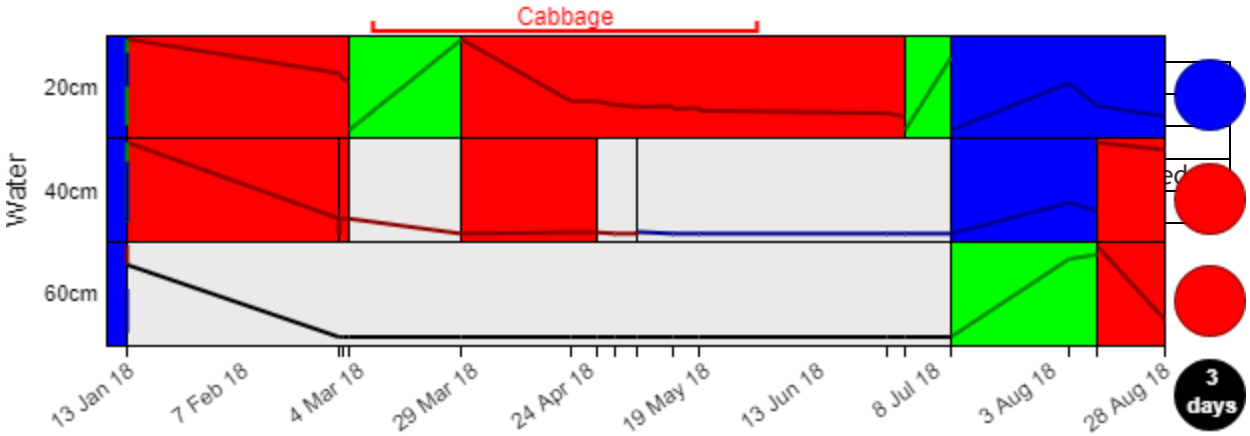


Figure 26: Soil Water Content: Mariam Malephe- trench bed outside the tunnel

For her trench bed outside the tunnel, shown in Figure 26, her soil was mostly too dry to even take readings. Since July, when her latest batch of spinach was planted, she has tried harder to ensure a blue reading when she irrigates.

6.3.1.6 Soil fertility

Soil samples were taken in a few of the villages where the farmer led experimentation is taking place, to give a baseline for soil fertility status in these areas, against which later samples from the different CSA practices can be compared.
The results are shown in the table below.

Table 13: Soil fertility analysis results for four villages in Limpopo.

			Required			
Village name	**Clay %**	**Org. C %**	**N (kg/ha)**	**P (kg/ha)**	**K (kg/ha)**	**Lime (t/ha)**
Willows	22	1.7	80	60	0	0
Sedawa	14	<0.5	80	20	0	0
Oaks	24	0.7	80	20	0	0
Botshabelo	25	<0.5	80	20	0	0

From the brief summary above it can be seen that the soils have extremely low percentages of organic carbon and are generally sandy-clay soils. This information will need to be augmented with soil health information as well (in particular soil aggregates, microbial respiration and organic Nitrogen) to improve on the potential of soil fertility and soil health to be used as indicators for impact of CSA practices.

6.3.1.7 Learning and conclusions

Learnings have included the following observations:

- Each farmer makes his/her own decisions which is different from those of other farmers (e.g. when to irrigate, how much water to apply and how often). This ten provides for large variability in the results from the same experiment precludes rigorous scientific analysis in some cases. Because of this also, a lot more descriptive information is required around the experiments to understand what the data means as some of the farmers change what they are doing along the way
- The monitoring for the farmer led experiments is intensive, as one cannot leave them to do the recording for extended periods of time without going back to check.
- The monitoring process has been changed over this last season from leaving the farmers to record how they will, to designing forms for them, to getting the LFs and interns to collect forms on a more regular basis and more recently to have the interns and field workers “interrogate” the forms with the farmers before submitting them; all to ensure more rigour in the data collection process.
- Just working with three farmers per site has not worked well. In future 5 farmers per site will be needed to ensure that some comparative data at least is available
- Specific time will need to be allocated on a monthly basis to ensure the data has been submitted (1 week/ month for the 25 odd farmer led experiments presently being conducted) and then to record this data properly for timely analysis (1-2 days). It did not work well to keep all the data in rough versions and then try and analyse all of it towards the end of the season.
- The potential for having a researcher managed experimental site is being considered.
- Processes for working with farmers in learning from and analysing data from the measurements need to be more formally designed and implemented.
- There is some confusion about what a good yield represents under any particular circumstance. Farmers have an impression that their yields used to be better, but they do not have a meticulous way of working out what their yields are and only compare now with the past. So, in a way a trend of low yields becomes entrenched, as they are not even aware that it I possible to obtain higher yields. Some work with farmers in terms of working with more generic values for yields for particular crops and benchmarking these against the yields they are now receiving is required, to be able to make sense of an indicator around improved yields.
- Farmers acknowledge the importance of having a system that could allow them to make informed decisions about prioritization of practices (however, such systems should allow room for famers to make their own judgements and decisions.
- Because of this, the next round of experimentation will need to widen to include specific choices of practices by the farmers and our indictors for impact will need to be generic enough to be able to compare different sets of practices against one another in terms of improved productivity and livelihoods.