How do we justify restoration efforts as mechanisms for replenishing water use of companies that rely on water from the upper uThukela Catchment?

The Institute of Natural Resources (INR) is undertaking some restoration demonstration activities at Stulwane, in partnership with Mahlathini Development Foundation. Stulwane is located in the Northern Drakensberg, about 20 km from the town of Winterton. Mahlathini has ongoing projects in the area and has been working with a group of youth that were initially appointed as Ecochamps through the *Amanzi Ethu Nobontu* programme. With technical guidance from the INR team, and under the oversight of Mahlathini field staff, this group of youth have been busy with marking contours, using a simple A-frame tool and constructing brushpacks from wattle that they have been clearing in the vicinity of the gulley that they are stabilizing. They have been monitoring sediment capture and revegetating the areas where the sediment is providing a good growing environment for grass seed.

With the majority of the brushpacks in place, the decision was taken to use this site for collecting information about how the interventions potentially reduce run-off and increase infiltration. Sylvester Selala, who has installed run-off plans in conservation agriculture experiments for Mahlathini, spent time with the youth group, explaining the choice of positions for the run-off plots and developing a monitoring process for measuring both rainfall and run-off. Two of the young women that are part of the group have been appointed by INR to record both rainfall and run-off figures after any rainfall event. These are then sent through to INR for analysis.

So far, the process has been interesting, but not without its challenges. Intense storms accompanied by high winds and heavy rainfall have disturbed some of the buckets, calling for innovative solutions to keep the buckets in position.

Figure 1: Run-off plots have been installed at different positions within the gulley that is being restored through the demonstration funded through the WWF-PepsiCo upper uThukela Partnership.

The challenge with run-off plots is finding a way of placing them that provides an indication of run-off within the broader landscape and how the interventions are reducing the run-off. Sylvester came up with the idea of constructing 'mini brushpacks' within one of the run-off plots to be able to represent the broader landscape, as shown in Figure 2.

Figure 2: Mini brushpacks constructed in one run-off plot to allow for a comparison with the adjacent plot.

Exploring the benefits of conservation agriculture with farmers

Besides their involvement with the restoration activities at Stulwane, Mahlathini is also supporting farmer experimentation that is exploring conservation agriculture (CA). Rainfall during the 2022/23 season has shown a trend of late onset, with low monthly averages for October and November and substantial rainfall in December. This is similar to the trends for the last three years. What is different, is that rainfall for January was extremely low this season, providing a marked mid-season drought effect. By late January, in Bergville, the majority of participants' maize were showing signs of drought stress. A few of the lead farmers, such as Phumelele Hlongwane, in Ezibomvini, however, were spared and their crops remained vibrant. The two photographs below were both taken on the 24 January 2023. The homesteads of Cabangani Hlongwane and Phumelele Hlongwane are right next to each other and their fields are separated by no more than 50m.

Both these farmers have been practicing CA since 2014, however the sites have quite different soil characteristics, which is likely to be responsible for the difference in the performance of the crops. Phumelele's fields have higher clay percentage (43% versus 27% for Cabanagani), N% (0.19 versus 0.15), organic carbon (2% versus 1.6%) and pH (5.1 versus 4.9). This set of photographs demonstrates that when coupled with good soils, CA has the opportunity to perform well even under circumstances of mid-season dry spells, which are likely to become more common as we experience the impacts of climate change, but only if all three principles of minimum tillage, increased soil cover and crop diversification are diligently followed.

Figure 6: (1) Maize showing heat stress in Cabangani Hlongwane's CA plot (above) and Maize and cover crops looking vibrant with good canopy cover in Phumelele Hlongwane's field (below). ***Note: The pictures were taken on the same day and fields are in very close proximity*****.**

Besides measuring the impact of CA on yield and soil characteristics, Mahlathini has also been exploring the impact of tillage practice on run-off. Participant farmers have been provided with monitoring sheets to record rainfall events and run-off for their CA trials and their control plots. Control plots were either ploughed and planted to mono-cropped maize or were a CA mono-cropped maize plot. The CA trial plots were averaged for a maize and bean intercropped plot and a maize only plot within the trial plot layout. Averages have been calculated for monthly rainfall and runoff for each area as recorded by the participant farmers. The table below indicates the records for the 7 Bergville participants, two of which are from Stulwane. The difference in runoff between the control and CA plots was not statistically significant.

Table 1: Summary of rainfall and runoff measurements for 7 participants in Bergville (October 2022-January 2023)

Village	Farmer	Rainfall (mm)	Runoff Control (litres)	Runoff CA trial (litres)

Eqeleni	Sthabiso Manyathi	244,3	26,7	28,5
	ThulisileZikode	474,0	15,3	19,0
Ezibomvini	Phumelele Hlongwane	392,5	24,7	23,6
Stulwane	Nelisiwe Msele	552,2	33,7	28,3
	Nothile Zondi	458,9	63,6	74,8
Vimbukhalo	Sibongile Mpulo	387,0	13,1	13,1
	Zweni Ndaba	418,5	14,1	21,8
Mean		418,2	27,3	29,9
P-value (Wilcoxin)		0,21		
Percentage rainfall conversion			7%	7%

The small table below compares the annual runoff results for the last 4 years

% Rainfall conversion to runoff (N=6-8)	**Runoff CA trial plot (L)**	**Runoff control plot (L)**
2019/2020	4%	7%
2020/2021	6%	11%
2021/2022	5%	7%
2022/2023	7%	7%
Average	**5,5%**	**8%**

This indicates that for the last two years of exceptionally high rainfall runoff between the CA trial and the conventional control plots has been similar, unlike the previous years where there is markedly less runoff in the Ca trial plots. In addition, runoff from the trial plots are consistently free of sediment, which is not the case with the conventionally tilled plots.

This indicates the positive effects of implementation of Conservation Agriculture on reduced runoff, reduced sedimentation and increased infiltration, but also indicates the limits of this intervention with really high levels of rainfall that lead to saturation of soil.