



Weather Index Insurance The Case for South Africa

SHADRECK MAPFUMO

09 February 2007

Prepared for FinMark Trust
www.finmarktrust.org.za

<u>1</u>	<u>ACKNOWLEDGEMENTS</u>	<u>3</u>
<u>2</u>	<u>INTRODUCTION</u>	<u>3</u>
<u>3</u>	<u>WEATHER INDEX INSURANCE FOR DROUGHT RISK</u>	<u>3</u>
<u>4</u>	<u>PRE-REQUISITES FOR WEATHER INDEX INSURANCE FOR SMALL HOLDER FARMERS</u>	<u>4</u>
<u>5</u>	<u>DEVELOPING AND IMPLEMENTING A MICRO-LEVEL WEATHER INDEX INSURANCE PROGRAM.....</u>	<u>5</u>
<u>6</u>	<u>MAIN CHALLENGES TO WEATHER INDEX INSURANCE</u>	<u>6</u>
<u>7</u>	<u>MANAGING WEATHER INDEX INSURANCE CHALLENGES</u>	<u>7</u>
<u>8</u>	<u>FEASIBILITY ANALYSIS OF WEATHER INDEX INSURANCE IN SOUTH AFRICA</u>	<u>7</u>
8.1	CAN WEATHER INDEX INSURANCE WORK ?	7
8.2	CO-VARIANT AND BASIS RISK	8
8.3	CONCLUSION AND NEXT STEPS	9
<u>9</u>	<u>BACKGROUND READINGS</u>	<u>10</u>
<u>10</u>	<u>APPENDIX</u>	<u>10</u>

1 Acknowledgements

We would like to thank Erin Bryla and Joanna Syroka of the World Bank's Commodity Risk Management Group, and Professor Gerhard Coetzee for comments and additions to this paper. The views expressed in this paper do not necessarily represent the position of The World Bank, Opportunity International Network or the University of Pretoria. Any errors in this paper are the author's own.

2 Introduction

South African smallholders farmers like other farmers in Africa, are faced with high yield variability due to weather related perils such as drought, floods and snow. Their plight is made worse by their inability to access high yielding, disease resistant seed varieties and other required inputs such as fertilizer.

To access input loans, they would need to pledge their assets as collateral to banks or microfinance institutions. Most of these farmers do not have such assets. The lack of collateral and their high dependence on rainfall make smallholder farmers high risks and most banks do not avail their loans to them.

On the other hand, medium and large-scale farmers not only have access to finance, but also access risk transfer mechanisms such as multi-peril crop insurance (MPCI). Though not very efficient, MPCI has not even been attempted as a risk transfer mechanism in the micro-level farming community. This is because issues of moral hazard, adverse selection and high monitoring and administration costs would be even worse with these farmers than with medium and large scale ones. Given the size of the land holding by smallholder farmers, per field loss adjustment costs are considerable and hence such an approach is inappropriate.

In light of the above, our challenge then, is to design and implement an alternative efficient and cost effective crop failure insurance program that can easily be reinsured and distributed to micro-level farmers. Weather index insurance attached to input finance proved very popular in Malawi where two financial institutions provided loans to farmers to purchase high yielding seed and other chemicals. In times of drought, the farmers' debt to the financier is paid off. Since the majority of farmers in the pilot have little or no collateral the insurance policy is acting as some form of collateral to the bank.

3 Weather index insurance for drought risk

This is a product designed to provide compensation to farmers when the rainfall during a crop growing cycle is insufficient for farmers to grow and optimize their yields. Weather index insurance does not measure changes in yields instead it measures changes in rainfall assuming that if rainfall is bad farmer's yields will be poor also. It is important therefore to establish upfront the relationship between yield and rainfall. In establishing this relationship it is critical to consider the different amounts of rainfall needed for optimal growth at different points in the crop's life.

Once a strong correlation is identified in order to compensate farmers, instead of determining how bad a drought is by looking at the condition of the plants in a farmer's field, drought is determined by measuring the amount of rain that was received. Because making this measurement is impossible to do on each individual farmer's plot weather index insurance measures the amount of rain recorded at the local meteorological station. If a

farmer lives close enough to the weather station it is assumed that the rainfall received at the station is similar to the rainfall received on the farmer's plot. Though the rainfall will not always be exactly the same, in cases of severe drought it is assumed that that all farmers within a given radius will be affected in a similar manner. For example, in Malawi a radius of 20-30-kilometres was used; this value will vary from area to area and will depend on the climatology and topography of a region. It is the effects of these severe droughts that the insurance program aims to protect farmers against.

Pertinent details of a weather index contract could look as follows:

Crop	Groundnuts
Measurement station	ABC Weather Station
Insured farmers	Those within 20 kilometres of the Station
Peril covered	Drought
Proxy for the peril	Rainfall deficiency
Contract start date	Dynamic start date depending on a given sowing trigger.

Contract details:

Parameter	Crop growth stage		
	Germination and establishment	Flowering	Maturity
Length of phase	50 days	30 days	40 days
Upper trigger	35mm	140mm	35mm
Lower trigger	30	30	20
Payout rate (per mm)	R 1600	R 73	R533
Sum Insured	R 8000	R 8000	R 8000
Maximum contract payout	R 8000		
Premium rate	7% of maximum contract payout.		

Assume that Mr X is one of the smallholder farmers that are insured against the rainfall readings from ABC weather station. If at the end of 50 days from the contract start date the station has received a cumulative rainfall greater than 35mm, he will receive no pay out. If the rainfall measurement is less than 35mm he begins receiving compensation related to the severity of the deficit. For example, if the station has received 33 mm, he receives R 3,200 (calculated as (upper trigger less amount received) x payout rate). For accumulative total equal or less than 30mm, the farmer receives R8, 000. It is assumed that rainfall total equal or below 30mm for that growth stage results in permanent damage to the crop such that even if the crop receives enough rain later, it will still not survive and yield anything meaningful. The same argument goes for flowering and maturity stages. It is important to note that the idea here is to try and indemnify the farmer. This leads to the restriction that the total payout from the contract is R8, 000. In this particular case, Mr X would have paid R560.00 for this cover. This could either be paid upfront or capitalised.

4 Pre-requisites for weather index insurance for small holder farmers

In order to design weather index insurance contracts for a country, the following are pertinent:

1. Reliable network of weather stations.
2. Quality historic rainfall data covering 30-40 years.
3. Where one is using the Water Requirement Satisfaction Index in the crop modelling, evapo-transpiration figures per weather station will also be required.
4. High density of farmers around each specified meteorological station.
5. Relatively uniform weather patterns within a specified radius of the weather station.
6. Relatively similar soil water holding capacities for farms insured against a specified station.
7. Institutional delivery channel for reaching farmers who is committed to the project and has the technical capacity to manage this process.
 - a. Distribute and market products to farmers
8. Ability to provide education and training to farmers
9. Insurer or risk taker willing to hold risk or act as a market intermediary for the risk

5 Developing and implementing a micro-level weather index insurance program

Detailed explanation of how to develop and manage a weather index project is beyond the scope of this paper. However, an outline of the major steps followed in such an exercise is in order. The steps can be summarised as follows:

Step 1: Identification of potential pilot areas and weather stations.

Step 2: Identification of potential stakeholders.

Step 3: Risk assessment for potential stakeholders and clients.

Step 4: Identification of significant client exposure to weather, which entails the following tasks:

- Identifying regions that are at risk of adverse weather e.g. drought or excess rain.
- Choosing weather measurement that is the most accurate proxy for the adverse weather e.g. rainfall as proxy for drought.
- Identifying crop critical periods. This helps identify the length of the period requiring insurance and how that can be split into crop growth periods.

Step 5: Quantifying the impact of the adverse weather on clients' revenues.

This step is done to quantify the total amount of insurance that is required as well as the pay out rate per unit of exposure. Total amount of insurance can be derived from an analysis of yields or input costs. The payout rate per exposure unit is done either as yield volume lost per unit index (through such techniques as best year worst year analysis or regression analysis) or Rand value lost per unit index. The values R1600 and R8000 in the table in section 2 were arrived at through this process.

Step 6: Structure a contract that pays out when adverse weather occurs.

Weather index insurance contracts for smallholder farmers can be delivered as either stand alone insurance or bundled together with credit. When sold as stand

alone, the aim is to compensate the farmer for the loss in income that was supposed to have been generated had the adverse weather not occurred. For bundled products the aim is usually to insure the cost of inputs.

Step 7: Execute the contract in optimal form.

This is when the contract is insured and or/ reinsured with local and external insurance companies. One has to look at the local regulatory environment in order to ensure that such a contract can be executed in line with regulatory requirements.

Step 8: Field testing of the contract.

Step 9: Refinement of the contract based on clients' feedback.

Step 10: Drafting of policies and paperwork/finalization of institutional arrangement.

Step 11: Reinsurance.

Step 12: Training and education.

Step 13: Marketing.

Step 14: Monitoring.

6 Main challenges to Weather index Insurance

- (i) Identification of committed and willing stakeholders who have a business interest in the project.
- (ii) Making sure that project stakeholders, especially farmers, do understand the operational details of the contract.
- (iii) Farmers' ability to pay premium when they have little access to cash or willingness to spend limited cash income on insurance.
 - a. This is especially true where the product is sold unbundled to other services or instruments without any links to credit.
 - b. Insurance for any type of risk is relatively new in developing countries requiring not investment in farmer education but a shift in a potential clients approach to managing risk.
- (iv) Availability of historic data and a good network of weather stations.

In most countries this is the main challenge. Countries affected by war and other disasters rarely have good networks, let alone good weather data.

- (v) Basis risk

Basis risk is defined as mismatch between coverage and the actual results. This risk will always be there with weather index based insurance since rainfall received by the farmer will not always be the same as that received at the weather station.

- (vi) Co-variant risk.

Co-variant risk is a challenge to an economy that wants to retain all of the insured risk. In countries where co-variant risk is high, basis risk is low as the rainfall patterns are usually similar across main regions. This bodes well for farm level weather index insurance.

7 Managing Weather Index Insurance Challenges

The following table gives a summary of some of the techniques that can be used in managing weather index insurance product design and implementation challenges.

Challenge	Risk management technique
Identification of stakeholders	Early planning and coordination between participants. Selection and participation of stakeholders who are organizationally and managerial strong.
Data availability	If data is available but has some gaps, these can be extrapolated from the available data.
Willingness/ Ability to pay	Emphasis on education of clients; Linking insurance to other products; Product testing and piloting to demonstrate the use of the instruments
Misunderstanding of product concepts by stakeholders.	Training and education of stakeholders.
Basis risk	<p>The following are the main ways advocated by weather index practitioners such as Joanna Syroka of the World Bank:</p> <ul style="list-style-type: none"> ○ Writing contracts on stations near a farmer's field if possible; ○ Design contracts as catastrophe as opposed to working covers; ○ Writing contracts on basket of stations in a region to capture extreme events that impact a whole area; ○ Well thought-out and appropriate contract structuring.
Co-variant risk	Co-variant risk is best managed through either reinsurance or reciprocal business exchange arrangements with countries that have low or negative weather parameter correlations with the country in question.

8 Feasibility analysis of Weather Index Insurance in South Africa

8.1 Can Weather index insurance work?

Before deciding to implement weather index insurance, a country has to evaluate how it performs against the seven pre-requisites listed above. The table below shows whether or not South Africa meets the required pre-requisites.

Pre-requisite	SA status	Pre-	Pre-

		requisite met	requisite not met
1. Network of weather stations	95 high quality automatic weather stations.	X	
2. Historic data	53 years of good quality data available	X	
3. Evapo-transpiration data	Available at each of the 95 station.	X	
4. Relatively uniform weather patterns	High co-variance of October to April rainfall figures between stations.	X	
5. Ability to provide education and training.	This can be provided by the Opportunity International and the World Bank's Commodity Risk Management Group.	X	
Institutional delivery channel	To be determined.	?	?
5. Density of smallholder farmers around weather stations.	To be investigated.	?	?
6. Similar water holding capacities around the station	To be investigated.	?	?
7. Willing stakeholders	Aim of this paper.		

The results of this analysis are that weather index insurance is a potentially feasible product for South African smallholder farmers as long as we have willing stakeholders.

8.2 Co-variant and basis risk

A feasible way to measure a country's covariant risk is through a correlation analysis of historic rainfall figures at the target weather stations. The actual covariant risk is difficult to measure as such issues as soil type, evapo-transpiration and the way the contract is structured affect it. Trigger levels are likely to be different from one contract to the other. All these issues are ignored when performing correlation analysis using rainfall figures.

A correlation coefficient analysis of 53 years of October-April data is statistically significant at the 99% confidence level if its value is over 35.17%. This assumes a Gaussian time series but precipitation is known to be non-Gaussian. In order to take care of this non-Gaussian nature of rainfall, we used a square root transformation and performed the correlation analysis on the transformed values. Though the following results are based on the transformed values, the results are similar to those obtained before transformation.

The table below shows the covariant risk per province. Co-variant risk is hereby defined as number of correlations above 35.17% divided by the total number of correlation coefficients calculated for the province.

Province	Total correlation coefficients. (CC)	CC above 35.17%	Co-variant risk (%)
Free state	630	614	97.5 %
Limpopo	28	28	100%
Gauteng	91	76	83.5%
Mpumalanga	105	97	92%
KwazuluNatal	45	45	100%

NorthWest	136	136	100%
Total	1035	996	96%

To find out what effect diversification would take on the above correlations, a correlation analysis was done involving all stations in the country. We assume that the total sum insured per station is the same for all stations thereby allowing us to use equal weighting. The results of this later analysis is as follows:

Province	Total correlation coefficients (C.C)	C.C above 35.17%	Co-variant risk (%)
All provinces	4560	3565	78%

On the basis of the above analysis we can conclude that there is high co-variant risk in South Africa. This may be managed through reinsurance and reciprocal risk exchanges with other African countries. Ulrich Hess and Joanna Syroka (1) found the following correlations between South Africa and other African Countries.

Country	Correlation with SA	Country	Correlation with SA
Angola	0.44	Namibia	0.60*
Botswana	0.86*	Seychelles	0.02
Congo	0.39	Swaziland	0.74*
Lesotho	0.83*	Tanzania	-0.08
Malawi	0.08	Zambia	0.43
Mauritius	0.23	Zimbabwe	0.62*
Mozambique	0.40		

The correlations marked with (*) are statistically significant at 99% significant level. This means that effective reciprocal exchange programs cannot be effected solely with Botswana, Lesotho, Namibia, Swaziland and Zimbabwe. Best diversification benefits can be reaped from exchanges with Angola, Congo, Malawi, Seychelles, Tanzania and Zambia.

The high covariant risk and a good network of weather stations gives confidence that basis risk for drought coverage will be less of an issue in South Africa than in other countries where the spatial and temporal distribution of rainfall is less covariant. Using techniques mentioned above can further minimize it. Thorough product education and training for stakeholders and farmers will further serve to manage expectations as to what these products can and cannot do.

Matrices of correlation coefficients are included in the appendix for the interested reader.

8.3 Conclusion and next steps

The feasibility of weather index insurance for smallholder farmers in South Africa is dependent of the availability of institutional delivery channels, insurers/reinsurers and project sponsors. The country has a good network of weather stations and high quality historical data. Basis risk though always present with index-based contracts, may be less for drought risk in South Africa than in other countries due to high observed co-variance of rainfall between stations. Well thought-out structuring of contracts will also lead to a reduction in basis risk. If designed and retailed together with product education and training to farmers and stakeholders there appears to be strong potential for these products in South Africa.

To an insurer, high co-variant risk is a concern. However, there are many international reinsurers that have high appetite for risks from Africa. Africa risks are negatively correlated with other risks that they have with their portfolios. Another way to manage this risk would be to enter into reciprocal exchanges with countries such as Angola, Congo, Malawi, Seychelles, Tanzania and Zambia. There are already micro-insurance programs running in Malawi and Tanzania.

In order to implement weather index insurance in South Africa, the following steps would need to be followed:

1. Find pilot stakeholders.
2. Find pilot sponsors.
3. Identify crops and regions to be insured.
4. Collect updated weather data.
5. Involve experts in understanding crop behaviour, farmers' practices and crop modelling.
6. Structure the product with the stakeholders.
7. Launch the pilot.
8. Reinsure the risk.

9 Background readings

- 1) J.Syroka and U. Hess. 2005, Weather - Based Insurance in Southern Africa. The case of Malawi.

10 Appendix

The correlation coefficients given below were calculated from the square root of the October to April cumulative rainfall for years 1950-2002. Although the cumulative rainfall totals were transformed the statistical significance of the correlation coefficients should still be interpreted with caution. The numbers 1-95 refer to the station referenced on the left column.

Micro Insurance Agency



Countrywide correlation coefficients																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Bethlehem	1.00																		
2 Bloemfontein	0.47	1.00																	
3 Boshof	0.44	0.69	1.00																
4 Bothaville	0.64	0.59	0.58	1.00															
5 Brandfort	0.49	0.67	0.71	0.66	1.00														
6 Bultfontein	0.48	0.61	0.61	0.62	0.71	1.00													
7 Clocolaan	0.66	0.45	0.41	0.64	0.69	0.60	1.00												
8 Dewets	0.58	0.69	0.66	0.66	0.69	0.68	0.42	1.00											
9 Excelsi	0.56	0.49	0.61	0.62	0.67	0.53	0.65	0.50	1.00										
10 Ficks	1.00	0.47	0.44	0.64	0.49	0.48	0.66	0.58	0.56	1.00									
11 Fouries	0.60	0.36	0.44	0.50	0.53	0.40	0.67	0.41	0.57	0.60	1.00								
12 Frankf	0.43	0.51	0.37	0.52	0.51	0.39	0.45	0.41	0.51	0.43	0.24	1.00							
13 Harrism	0.57	0.38	0.32	0.54	0.48	0.47	0.65	0.36	0.56	0.57	0.60	0.61	1.00						
14 Heilbron	0.61	0.45	0.44	0.64	0.59	0.42	0.53	0.45	0.58	0.61	0.37	0.78	0.64	1.00					
15 Hennen	0.60	0.58	0.60	0.80	0.69	0.63	0.62	0.53	0.64	0.60	0.48	0.67	0.60	0.76	1.00				
16 Koppies	0.51	0.44	0.56	0.63	0.58	0.43	0.46	0.48	0.45	0.51	0.43	0.52	0.55	0.71	0.74	1.00			
17 Kroons	0.53	0.43	0.51	0.68	0.61	0.59	0.61	0.42	0.50	0.53	0.31	0.66	0.54	0.82	0.80	0.67	1.00		
18 Ladyb	0.70	0.62	0.59	0.69	0.73	0.65	0.79	0.60	0.76	0.70	0.63	0.54	0.67	0.69	0.72	0.61	0.62	1.00	
19 Lindley	0.58	0.45	0.55	0.58	0.60	0.47	0.62	0.41	0.65	0.58	0.48	0.60	0.60	0.73	0.71	0.60	0.69	0.67	1.00
20 Marquard	0.67	0.47	0.57	0.62	0.60	0.62	0.71	0.50	0.77	0.67	0.55	0.58	0.70	0.62	0.70	0.52	0.59	0.79	0.64

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21 Odendaal	0.57	0.45	0.53	0.73	0.63	0.61	0.61	0.52	0.57	0.57	0.33	0.64	0.50	0.70	0.77	0.61	0.76	0.67	0.57	0.60
22 Parys	0.42	0.48	0.44	0.60	0.50	0.47	0.57	0.36	0.51	0.42	0.35	0.57	0.61	0.72	0.71	0.64	0.66	0.71	0.56	0.63
23 Petrusb	0.40	0.68	0.78	0.60	0.76	0.66	0.54	0.71	0.64	0.40	0.51	0.47	0.49	0.50	0.59	0.53	0.46	0.74	0.54	0.62
24 Reitz	0.49	0.36	0.32	0.51	0.47	0.34	0.47	0.38	0.53	0.49	0.43	0.75	0.69	0.80	0.59	0.54	0.62	0.54	0.62	0.53
25 Sasol	0.62	0.40	0.43	0.58	0.49	0.49	0.41	0.58	0.42	0.62	0.32	0.61	0.46	0.72	0.63	0.57	0.63	0.48	0.55	0.51
26 Senekal	0.56	0.40	0.41	0.57	0.53	0.60	0.68	0.38	0.67	0.56	0.55	0.57	0.68	0.58	0.71	0.44	0.60	0.68	0.62	0.68
27 Theunis	0.62	0.52	0.58	0.72	0.74	0.73	0.71	0.64	0.67	0.62	0.51	0.66	0.61	0.70	0.79	0.59	0.73	0.69	0.63	0.75
28 Venters	0.59	0.55	0.47	0.72	0.60	0.62	0.68	0.54	0.67	0.59	0.47	0.55	0.68	0.60	0.77	0.56	0.60	0.73	0.62	0.69
29 Viljoenskroon	0.49	0.48	0.47	0.62	0.61	0.54	0.56	0.55	0.58	0.49	0.49	0.59	0.66	0.72	0.70	0.70	0.63	0.67	0.64	0.62
30 Virginia	0.59	0.48	0.42	0.76	0.56	0.57	0.60	0.49	0.52	0.59	0.38	0.59	0.54	0.65	0.80	0.57	0.66	0.72	0.54	0.66
31 Vrede	0.47	0.30	0.19	0.42	0.41	0.36	0.42	0.43	0.48	0.47	0.31	0.73	0.56	0.64	0.50	0.33	0.50	0.38	0.51	0.51
32 Vredefor	0.65	0.45	0.47	0.68	0.42	0.39	0.47	0.52	0.57	0.65	0.39	0.56	0.53	0.74	0.67	0.71	0.59	0.68	0.54	0.64
33 Welkom	0.54	0.53	0.57	0.74	0.70	0.62	0.63	0.53	0.59	0.54	0.42	0.59	0.54	0.61	0.78	0.58	0.72	0.68	0.65	0.68
34 Wesselsbron	0.48	0.59	0.69	0.72	0.72	0.70	0.52	0.57	0.63	0.48	0.33	0.54	0.47	0.69	0.77	0.68	0.74	0.71	0.63	0.58
35 Winburg	0.66	0.60	0.72	0.70	0.79	0.67	0.64	0.65	0.75	0.66	0.54	0.62	0.59	0.68	0.77	0.63	0.70	0.78	0.65	0.80
36 Pietersburg	0.33	0.29	0.11	0.40	0.28	0.26	0.43	0.21	0.28	0.33	0.23	0.40	0.39	0.52	0.34	0.25	0.47	0.38	0.40	0.31
37 Potgietersrus	0.39	0.43	0.27	0.42	0.30	0.37	0.31	0.38	0.26	0.39	0.20	0.47	0.38	0.54	0.44	0.39	0.46	0.39	0.38	0.38
38 Soutpansberg	0.51	0.41	0.38	0.60	0.44	0.36	0.36	0.49	0.30	0.51	0.31	0.43	0.38	0.53	0.63	0.55	0.49	0.49	0.29	0.45
39 Soutpansberg 1	0.48	0.38	0.19	0.57	0.34	0.46	0.45	0.46	0.40	0.48	0.32	0.42	0.46	0.47	0.54	0.28	0.45	0.53	0.33	0.43
40 Thabazimbi	0.42	0.54	0.42	0.48	0.50	0.47	0.24	0.61	0.42	0.42	0.21	0.60	0.37	0.65	0.56	0.47	0.53	0.44	0.37	0.42

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
21 Odendaal	1.00																			
22 Parys	0.57	1.00																		
23 Petrusb	0.49	0.59	1.00																	
24 Reitz	0.59	0.61	0.37	1.00																
25 Sasol	0.59	0.41	0.46	0.58	1.00															
26 Senekal	0.57	0.54	0.50	0.60	0.53	1.00														
27 Theunis	0.77	0.56	0.66	0.56	0.71	0.70	1.00													
28 Venters	0.63	0.66	0.58	0.46	0.56	0.74	0.74	1.00												
29 Viljoenskroon	0.64	0.65	0.61	0.65	0.52	0.56	0.68	0.58	1.00											
30 Virginia	0.72	0.63	0.49	0.49	0.51	0.56	0.71	0.64	0.67	1.00										
31 Vrede	0.49	0.32	0.31	0.72	0.69	0.57	0.69	0.51	0.56	0.42	1.00									
32 Vredefor	0.60	0.74	0.51	0.58	0.55	0.41	0.57	0.60	0.65	0.66	0.37	1.00								
33 Welkom	0.72	0.51	0.56	0.46	0.50	0.52	0.74	0.59	0.60	0.79	0.43	0.52	1.00							
34 Wesselsbron	0.78	0.69	0.69	0.47	0.50	0.49	0.73	0.65	0.67	0.71	0.31	0.65	0.69	1.00						
35 Winburg	0.73	0.60	0.72	0.58	0.60	0.60	0.82	0.64	0.67	0.71	0.54	0.65	0.75	0.78	1.00					
36 Pietersburg	0.35	0.39	0.15	0.44	0.37	0.35	0.33	0.43	0.20	0.28	0.29	0.27	0.27	0.30	0.25	1.00				
37 Potgietersrus	0.45	0.46	0.25	0.51	0.45	0.29	0.36	0.43	0.39	0.36	0.31	0.41	0.30	0.45	0.39	0.60	1.00			
38 Soutpansberg	0.55	0.44	0.34	0.41	0.50	0.40	0.50	0.56	0.40	0.58	0.39	0.48	0.47	0.46	0.50	0.41	0.43	1.00		
39 Soutpansberg 1	0.50	0.52	0.36	0.40	0.46	0.51	0.49	0.70	0.43	0.52	0.40	0.47	0.35	0.47	0.39	0.54	0.48	0.67	1.00	
40 Thabazimbi	0.50	0.46	0.46	0.55	0.65	0.38	0.56	0.51	0.43	0.45	0.55	0.50	0.49	0.56	0.55	0.49	0.61	0.59	0.54	1.00

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
41 Waterberg	0.31	0.32	0.17	0.49	0.38	0.38	0.26	0.41	0.30	0.31	0.04	0.57	0.39	0.64	0.49	0.37	0.55	0.38	0.34
42 Warmbad	0.50	0.36	0.26	0.52	0.32	0.39	0.31	0.44	0.39	0.50	0.22	0.57	0.41	0.61	0.54	0.34	0.50	0.42	0.36
43 Benoni	0.45	0.67	0.71	0.59	0.73	0.67	0.59	0.72	0.68	0.45	0.55	0.40	0.43	0.43	0.57	0.51	0.47	0.69	0.56
44 Boksburg	0.59	0.39	0.18	0.49	0.32	0.30	0.33	0.46	0.40	0.59	0.18	0.62	0.46	0.67	0.55	0.39	0.54	0.41	0.40
45 Bronkhor	0.52	0.29	0.18	0.38	0.27	0.23	0.23	0.46	0.35	0.52	0.13	0.51	0.29	0.54	0.38	0.29	0.41	0.27	0.29
46 Heidelber	0.53	0.53	0.41	0.63	0.46	0.47	0.46	0.46	0.45	0.53	0.27	0.67	0.49	0.76	0.70	0.55	0.68	0.57	0.58
47 Kempton	0.46	0.46	0.30	0.53	0.43	0.38	0.46	0.32	0.47	0.46	0.31	0.68	0.56	0.72	0.68	0.47	0.61	0.52	0.49
48 Krugers	0.64	0.51	0.35	0.64	0.52	0.51	0.53	0.60	0.45	0.64	0.37	0.65	0.59	0.70	0.65	0.50	0.63	0.58	0.54
49 Nigel	0.59	0.43	0.25	0.53	0.35	0.30	0.40	0.42	0.46	0.59	0.22	0.66	0.48	0.73	0.59	0.54	0.59	0.50	0.51
50 Oberrhol	0.21	0.14	0.07	0.23	0.15	0.29	0.25	0.23	0.34	0.21	0.22	0.34	0.43	0.31	0.24	0.26	0.23	0.29	0.23
51 Pretoria	0.39	0.53	0.35	0.53	0.49	0.36	0.28	0.46	0.48	0.39	0.16	0.72	0.47	0.67	0.53	0.42	0.51	0.46	0.33
52 Randfon	0.44	0.41	0.22	0.49	0.47	0.37	0.44	0.36	0.40	0.44	0.26	0.60	0.48	0.63	0.62	0.43	0.58	0.47	0.32
53 Springs	0.59	0.39	0.18	0.49	0.32	0.30	0.33	0.46	0.40	0.59	0.18	0.62	0.46	0.67	0.55	0.39	0.54	0.41	0.40
54 Vanderbi	0.51	0.55	0.43	0.59	0.49	0.45	0.39	0.57	0.40	0.51	0.34	0.67	0.44	0.70	0.65	0.58	0.61	0.53	0.47
55 Vereenig	0.51	0.55	0.43	0.59	0.49	0.45	0.39	0.57	0.40	0.51	0.34	0.67	0.44	0.70	0.65	0.58	0.61	0.53	0.47
56 Balfour	0.56	0.46	0.33	0.59	0.46	0.38	0.39	0.55	0.36	0.56	0.25	0.62	0.41	0.70	0.56	0.50	0.57	0.52	0.42
57 Belfast	0.37	0.32	0.29	0.32	0.37	0.17	0.20	0.41	0.25	0.37	0.16	0.44	0.13	0.45	0.31	0.22	0.39	0.23	0.29
58 Bethal	0.42	0.39	0.23	0.43	0.36	0.33	0.31	0.37	0.33	0.42	0.22	0.63	0.43	0.65	0.49	0.42	0.57	0.31	0.37
59 Carolina	0.35	0.30	0.22	0.46	0.31	0.31	0.21	0.35	0.27	0.35	0.07	0.58	0.34	0.63	0.51	0.42	0.57	0.31	0.40
60 delmas	0.46	0.44	0.15	0.41	0.38	0.32	0.37	0.41	0.29	0.46	0.18	0.58	0.45	0.58	0.51	0.38	0.49	0.38	0.34
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

41 Waterberg	0.45	0.52	0.31	0.60	0.57	0.39	0.42	0.50	0.37	0.42	0.48	0.45	0.36	0.50	0.40	0.54	0.62	0.43	0.52
42 Warmbad	0.49	0.43	0.32	0.53	0.63	0.47	0.58	0.49	0.31	0.56	0.55	0.48	0.50	0.43	0.50	0.47	0.49	0.47	0.44
43 Benoni	0.46	0.48	0.78	0.43	0.40	0.57	0.61	0.58	0.52	0.45	0.41	0.38	0.52	0.59	0.67	0.21	0.22	0.38	0.31
44 Boksburg	0.50	0.38	0.21	0.63	0.73	0.46	0.54	0.49	0.38	0.45	0.69	0.51	0.43	0.36	0.47	0.46	0.49	0.49	0.50
45 Bronkhor	0.40	0.13	0.20	0.44	0.76	0.36	0.54	0.41	0.25	0.29	0.67	0.41	0.36	0.22	0.43	0.37	0.36	0.45	0.41
46 Heidelber	0.64	0.63	0.39	0.65	0.82	0.56	0.65	0.58	0.48	0.53	0.55	0.59	0.48	0.59	0.53	0.52	0.55	0.49	0.45
47 Kempton	0.52	0.60	0.34	0.68	0.68	0.60	0.59	0.58	0.41	0.46	0.57	0.53	0.48	0.47	0.50	0.50	0.44	0.46	0.45
48 Krugers	0.64	0.50	0.47	0.62	0.69	0.57	0.67	0.63	0.58	0.51	0.62	0.56	0.50	0.49	0.59	0.45	0.57	0.54	0.52
49 Nigel	0.51	0.50	0.25	0.66	0.71	0.50	0.54	0.51	0.42	0.41	0.61	0.62	0.41	0.43	0.50	0.47	0.52	0.45	0.44
50 Oberrhol	0.14	0.25	0.22	0.29	0.38	0.44	0.36	0.54	0.30	0.16	0.54	0.31	0.21	0.07	0.28	0.24	0.20	0.26	0.34
51 Pretoria	0.52	0.46	0.40	0.68	0.62	0.43	0.52	0.44	0.44	0.48	0.57	0.52	0.49	0.46	0.51	0.39	0.51	0.43	0.41
52 Randfon	0.56	0.46	0.27	0.58	0.62	0.54	0.54	0.52	0.41	0.48	0.50	0.43	0.48	0.39	0.46	0.51	0.51	0.53	0.49
53 Springs	0.50	0.38	0.21	0.63	0.73	0.46	0.54	0.49	0.38	0.45	0.69	0.51	0.43	0.36	0.47	0.46	0.49	0.49	0.50
54 Vanderbi	0.55	0.53	0.49	0.63	0.82	0.51	0.61	0.49	0.53	0.51	0.53	0.60	0.47	0.52	0.56	0.42	0.56	0.48	0.50
55 Vereenig	0.55	0.53	0.49	0.63	0.82	0.51	0.61	0.49	0.53	0.51	0.53	0.60	0.47	0.52	0.56	0.42	0.56	0.48	0.50
56 Balfour	0.56	0.48	0.34	0.62	0.70	0.44	0.57	0.46	0.50	0.54	0.58	0.56	0.48	0.43	0.56	0.43	0.43	0.64	0.49
57 Belfast	0.33	0.00	0.23	0.26	0.56	0.13	0.41	0.19	0.05	0.12	0.46	0.21	0.31	0.24	0.40	0.29	0.36	0.30	0.16
58 Bethal	0.49	0.34	0.22	0.62	0.72	0.44	0.54	0.40	0.35	0.26	0.66	0.35	0.35	0.33	0.46	0.50	0.57	0.52	0.42
59 Carolina	0.46	0.34	0.25	0.55	0.59	0.27	0.40	0.32	0.36	0.36	0.51	0.39	0.31	0.40	0.43	0.41	0.52	0.46	0.38
60 delmas	0.42	0.43	0.20	0.61	0.64	0.42	0.48	0.50	0.36	0.40	0.58	0.46	0.37	0.28	0.43	0.49	0.55	0.51	0.56

41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59

41 Waterberg	1.00																			
42 Warmbad	0.71	1.00																		
43 Benoni	0.32	0.35	1.00																	
44 Boksburg	0.71	0.72	0.32	1.00																
45 Bronkhor	0.50	0.63	0.20	0.83	1.00															
46 Heidelber	0.70	0.72	0.40	0.79	0.74	1.00														
47 Kempton	0.71	0.67	0.38	0.77	0.56	0.89	1.00													
48 Krugers	0.65	0.65	0.44	0.79	0.66	0.76	0.67	1.00												
49 Nigel	0.67	0.61	0.36	0.91	0.74	0.82	0.82	0.73	1.00											
50 Oberrhol	0.26	0.29	0.27	0.35	0.45	0.22	0.30	0.43	0.32	1.00										
51 Pretoria	0.69	0.73	0.34	0.74	0.63	0.72	0.74	0.67	0.71	0.30	1.00									
52 Randfon	0.65	0.64	0.28	0.75	0.65	0.67	0.75	0.72	0.70	0.36	0.76	1.00								
53 Springs	0.71	0.72	0.32	1.00	0.83	0.79	0.77	0.79	0.91	0.35	0.74	0.75	1.00							
54 Vanderbi	0.64	0.56	0.44	0.73	0.64	0.81	0.74	0.70	0.79	0.25	0.70	0.62	0.73	1.00						
55 Vereenig	0.64	0.56	0.44	0.73	0.64	0.81	0.74	0.70	0.79	0.25	0.70	0.62	0.73	1.00	1.00					
56 Balfour	0.64	0.67	0.42	0.73	0.64	0.77	0.70	0.71	0.75	0.30	0.68	0.67	0.73	0.66	0.66	1.00				
57 Belfast	0.33	0.47	0.21	0.59	0.70	0.52	0.40	0.50	0.56	0.16	0.49	0.46	0.59	0.50	0.50	0.45	1.00			
58 Bethal	0.63	0.66	0.31	0.76	0.74	0.75	0.75	0.67	0.78	0.37	0.71	0.73	0.76	0.71	0.71	0.71	0.67	1.00		
59 Carolina	0.65	0.64	0.28	0.61	0.48	0.66	0.57	0.58	0.59	0.22	0.59	0.47	0.61	0.58	0.58	0.56	0.59	0.71	1.00	
60 delmas	0.66	0.62	0.28	0.85	0.74	0.66	0.68	0.70	0.78	0.42	0.72	0.82	0.85	0.68	0.68	0.72	0.48	0.73	0.53	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
61 Ermelo	0.44	0.38	0.20	0.41	0.33	0.30	0.36	0.33	0.39	0.44	0.20	0.69	0.48	0.69	0.53	0.37	0.58	0.39	0.39	0.

62 Groblersdal	0.32	0.32	0.13	0.41	0.40	0.29	0.36	0.27	0.32	0.32	0.25	0.42	0.38	0.46	0.42	0.18	0.44	0.27	0.44	0.
63 Highveld	0.42	0.38	0.18	0.39	0.28	0.31	0.33	0.34	0.25	0.42	0.35	0.55	0.49	0.54	0.43	0.33	0.49	0.37	0.31	0.
64 Lydenburg	0.37	0.19	0.08	0.37	0.34	0.24	0.35	0.20	0.15	0.37	0.30	0.42	0.38	0.50	0.37	0.35	0.46	0.25	0.40	0.
65 Middelburg	0.37	0.27	0.22	0.43	0.33	0.25	0.27	0.35	0.34	0.37	0.20	0.54	0.40	0.59	0.46	0.37	0.53	0.25	0.40	0.
66 PietRetief	0.30	0.23	0.21	0.30	0.07	0.26	0.05	0.25	0.21	0.30	0.05	0.27	0.24	0.31	0.32	0.26	0.30	0.27	0.21	0.
67 Standerton	0.38	0.40	0.28	0.41	0.42	0.45	0.32	0.42	0.43	0.38	0.22	0.73	0.55	0.75	0.56	0.44	0.62	0.45	0.49	0.
68 Volksrust	0.34	0.26	0.23	0.36	0.34	0.17	0.29	0.32	0.30	0.34	0.22	0.56	0.40	0.56	0.46	0.46	0.46	0.31	0.40	0.
69 Wakkerstroom	0.34	0.40	0.39	0.41	0.46	0.34	0.37	0.34	0.44	0.34	0.27	0.62	0.52	0.64	0.58	0.55	0.59	0.48	0.50	0.
70 Witbank	0.32	0.31	0.21	0.35	0.23	0.22	0.14	0.37	0.21	0.32	0.01	0.58	0.25	0.61	0.37	0.39	0.52	0.18	0.30	0.
71 Bergville	0.53	0.33	0.29	0.44	0.33	0.43	0.46	0.49	0.44	0.53	0.36	0.60	0.71	0.60	0.55	0.48	0.56	0.49	0.48	0.
72 Glencoe	0.25	0.22	0.16	0.18	0.01	0.12	0.00	0.20	0.16	0.25	0.02	0.46	0.34	0.51	0.30	0.30	0.38	0.25	0.41	0.
73 Dannhauser	0.25	0.22	0.16	0.18	0.01	0.12	0.00	0.20	0.16	0.25	0.02	0.46	0.34	0.51	0.30	0.30	0.38	0.25	0.41	0.
74 Dundee	0.25	0.22	0.16	0.18	0.01	0.12	0.00	0.20	0.16	0.25	0.02	0.46	0.34	0.51	0.30	0.30	0.38	0.25	0.41	0.
75 Estcourt	0.42	0.41	0.37	0.32	0.35	0.44	0.30	0.46	0.36	0.42	0.20	0.43	0.51	0.49	0.48	0.37	0.45	0.45	0.30	0.
76 Newcastle	0.47	0.17	0.16	0.27	0.20	0.20	0.22	0.39	0.26	0.47	0.09	0.47	0.30	0.49	0.33	0.29	0.41	0.24	0.37	0.
77 Paulpietersburg	0.43	0.30	0.33	0.35	0.22	0.30	0.20	0.37	0.22	0.43	0.18	0.49	0.47	0.48	0.42	0.40	0.42	0.30	0.38	0.
78 Utrecht	0.40	0.29	0.22	0.34	0.34	0.31	0.38	0.35	0.42	0.40	0.31	0.57	0.63	0.53	0.45	0.42	0.38	0.48	0.45	0.
79 Vryheid	0.41	0.26	0.24	0.29	0.21	0.28	0.14	0.38	0.24	0.41	0.05	0.53	0.38	0.49	0.40	0.34	0.42	0.27	0.38	0.
80 Bloemhof	0.57	0.62	0.64	0.75	0.63	0.56	0.46	0.66	0.45	0.57	0.37	0.45	0.39	0.49	0.60	0.58	0.54	0.61	0.49	0.

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 .

61 Ermelo	0.48	0.37	0.24	0.68	0.67	0.50	0.50	0.43	0.39	0.35	0.67	0.40	0.32	0.33	0.45	0.52	0.57	0.53	0.50	0.
62 Groblersdal	0.28	0.19	0.17	0.46	0.51	0.35	0.41	0.38	0.29	0.31	0.48	0.14	0.32	0.21	0.37	0.54	0.43	0.37	0.36	0.

63 Highveld	0.38	0.26	0.22	0.52	0.60	0.39	0.43	0.32	0.32	0.33	0.54	0.34	0.42	0.18	0.38	0.42	0.44	0.48	0.37	0.
64 Lydenburg	0.34	0.20	0.08	0.43	0.61	0.26	0.38	0.34	0.21	0.17	0.46	0.21	0.33	0.20	0.24	0.60	0.41	0.41	0.44	0.
65 Middelburg	0.39	0.28	0.22	0.54	0.65	0.36	0.46	0.37	0.23	0.24	0.59	0.30	0.33	0.32	0.42	0.50	0.54	0.51	0.41	0.
66 PietRetief	0.28	0.18	0.15	0.30	0.33	0.19	0.13	0.23	0.21	0.26	0.22	0.33	0.14	0.21	0.22	0.31	0.32	0.31	0.40	0.
67 Standerton	0.44	0.42	0.37	0.68	0.72	0.49	0.61	0.48	0.51	0.43	0.81	0.44	0.45	0.39	0.56	0.46	0.51	0.44	0.40	0.
68 Volksrust	0.33	0.20	0.19	0.53	0.60	0.40	0.45	0.32	0.42	0.32	0.66	0.30	0.37	0.21	0.41	0.27	0.26	0.54	0.32	0.
69 Wakkerstroom	0.44	0.45	0.35	0.63	0.60	0.48	0.49	0.40	0.52	0.41	0.60	0.41	0.47	0.41	0.56	0.27	0.40	0.50	0.31	0.
70 Witbank	0.46	0.32	0.18	0.54	0.62	0.18	0.41	0.29	0.28	0.20	0.54	0.44	0.22	0.35	0.35	0.50	0.59	0.46	0.42	0.
71 Bergville	0.42	0.48	0.40	0.56	0.55	0.49	0.61	0.53	0.56	0.48	0.54	0.58	0.40	0.43	0.50	0.31	0.37	0.37	0.50	0.
72 Glencoe	0.25	0.25	0.09	0.56	0.41	0.32	0.15	0.17	0.25	0.20	0.41	0.34	0.12	0.20	0.29	0.24	0.33	0.21	0.16	0.
73 Dannhauser	0.25	0.25	0.09	0.56	0.41	0.32	0.15	0.17	0.25	0.20	0.41	0.34	0.12	0.20	0.29	0.24	0.33	0.21	0.16	0.
74 Dundee	0.25	0.25	0.09	0.56	0.41	0.32	0.15	0.17	0.25	0.20	0.41	0.34	0.12	0.20	0.29	0.24	0.33	0.21	0.16	0.
75 Estcourt	0.36	0.39	0.34	0.47	0.52	0.46	0.45	0.44	0.46	0.37	0.42	0.45	0.27	0.31	0.47	0.30	0.35	0.51	0.41	0.
76 Newcastle	0.32	0.13	0.19	0.47	0.62	0.29	0.41	0.29	0.29	0.26	0.62	0.33	0.33	0.18	0.35	0.27	0.31	0.36	0.41	0.
77 Paulpietersburg	0.30	0.20	0.23	0.48	0.58	0.34	0.38	0.29	0.32	0.41	0.50	0.35	0.38	0.28	0.37	0.26	0.32	0.51	0.35	0.
78 Utrecht	0.34	0.41	0.33	0.63	0.58	0.54	0.47	0.52	0.39	0.32	0.71	0.41	0.37	0.25	0.47	0.28	0.36	0.45	0.41	0.
79 Vryheid	0.33	0.17	0.27	0.49	0.55	0.34	0.41	0.24	0.31	0.34	0.59	0.31	0.31	0.27	0.43	0.13	0.27	0.41	0.29	0.
80 Bloemhof	0.64	0.39	0.54	0.42	0.44	0.35	0.58	0.46	0.48	0.61	0.27	0.52	0.68	0.60	0.68	0.25	0.41	0.51	0.31	0.

41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59

61 Ermelo	0.65	0.62	0.28	0.78	0.72	0.69	0.72	0.66	0.76	0.35	0.67	0.75	0.78	0.69	0.69	0.67	0.64	0.88	0.76	0.
62 Groblersdal	0.55	0.52	0.22	0.60	0.55	0.61	0.59	0.60	0.51	0.24	0.52	0.57	0.60	0.48	0.48	0.55	0.50	0.66	0.59	0.
63 Highveld	0.52	0.61	0.31	0.69	0.63	0.67	0.69	0.64	0.67	0.33	0.64	0.69	0.69	0.65	0.65	0.69	0.55	0.83	0.59	0.

64 Lydenburg	0.47	0.37	0.11	0.56	0.52	0.58	0.58	0.54	0.56	0.29	0.44	0.58	0.56	0.55	0.55	0.57	0.55	0.69	0.53	0.
65 Middelburg	0.61	0.64	0.32	0.74	0.70	0.64	0.60	0.61	0.70	0.33	0.61	0.64	0.74	0.59	0.59	0.55	0.73	0.85	0.74	0.
66 PietRetief	0.32	0.40	0.11	0.34	0.29	0.34	0.29	0.27	0.28	0.19	0.38	0.27	0.34	0.27	0.27	0.30	0.19	0.27	0.60	0.
67 Standerton	0.61	0.62	0.41	0.72	0.65	0.69	0.68	0.65	0.69	0.55	0.68	0.57	0.72	0.69	0.69	0.62	0.54	0.72	0.70	0.
68 Volksrust	0.35	0.35	0.27	0.49	0.56	0.51	0.47	0.37	0.51	0.32	0.44	0.45	0.49	0.50	0.50	0.59	0.49	0.62	0.54	0.
69 Wakkerstroom	0.47	0.39	0.40	0.47	0.41	0.61	0.60	0.39	0.57	0.24	0.54	0.50	0.47	0.58	0.58	0.60	0.41	0.66	0.58	0.
70 Witbank	0.62	0.59	0.19	0.71	0.72	0.67	0.55	0.59	0.70	0.30	0.63	0.56	0.71	0.65	0.65	0.57	0.66	0.82	0.72	0.
71 Bergville	0.39	0.48	0.36	0.61	0.51	0.51	0.48	0.62	0.56	0.34	0.45	0.45	0.61	0.56	0.56	0.41	0.33	0.43	0.46	0.
72 Glencoe	0.36	0.28	0.23	0.44	0.35	0.46	0.42	0.30	0.54	0.24	0.32	0.22	0.44	0.44	0.44	0.41	0.28	0.45	0.50	0.
73 Dannhauser	0.36	0.28	0.23	0.44	0.35	0.46	0.42	0.30	0.54	0.24	0.32	0.22	0.44	0.44	0.44	0.41	0.28	0.45	0.50	0.
74 Dundee	0.36	0.28	0.23	0.44	0.35	0.46	0.42	0.30	0.54	0.24	0.32	0.22	0.44	0.44	0.44	0.41	0.28	0.45	0.50	0.
75 Estcourt	0.38	0.39	0.32	0.49	0.46	0.53	0.50	0.55	0.48	0.33	0.42	0.48	0.49	0.55	0.55	0.48	0.24	0.47	0.41	0.
76 Newcastle	0.36	0.44	0.21	0.63	0.70	0.44	0.33	0.40	0.53	0.30	0.43	0.43	0.63	0.41	0.41	0.45	0.48	0.49	0.46	0.
77 Paulpietersburg	0.36	0.41	0.24	0.48	0.50	0.44	0.39	0.34	0.44	0.18	0.41	0.40	0.48	0.46	0.46	0.49	0.38	0.49	0.48	0.
78 Utrecht	0.45	0.47	0.33	0.56	0.51	0.52	0.59	0.49	0.59	0.54	0.55	0.50	0.56	0.47	0.47	0.53	0.38	0.58	0.47	0.
79 Vryheid	0.37	0.43	0.29	0.56	0.60	0.40	0.35	0.41	0.50	0.19	0.42	0.34	0.56	0.46	0.46	0.42	0.50	0.54	0.59	0.
80 Bloemhof	0.27	0.40	0.54	0.37	0.31	0.50	0.33	0.57	0.43	0.05	0.50	0.35	0.37	0.50	0.50	0.57	0.38	0.32	0.35	0.

61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79

61 Ermelo	1.00																			
62 Groblersdal	0.63	1.00																		
63 Highveld	0.74	0.63	1.00																	
64 Lydenburg	0.61	0.67	0.65	1.00																

89 Potchefstroom	0.43	0.44	0.43	0.60	0.54	0.46	0.47	0.45	0.50	0.43	0.32	0.62	0.45	0.70	0.67	0.59	0.62	0.59	0.51	0.62
90 Rustenburg	0.54	0.55	0.44	0.64	0.60	0.55	0.41	0.65	0.58	0.54	0.34	0.61	0.47	0.66	0.67	0.52	0.55	0.55	0.46	0.53
91 Schweizer	0.55	0.67	0.65	0.82	0.67	0.67	0.48	0.67	0.60	0.55	0.32	0.52	0.44	0.61	0.72	0.64	0.57	0.73	0.50	0.60
92 Swartruggens	0.65	0.55	0.42	0.63	0.49	0.42	0.37	0.62	0.42	0.65	0.33	0.51	0.33	0.61	0.59	0.38	0.50	0.51	0.41	0.49
93 Ventersruggens	0.40	0.49	0.47	0.61	0.54	0.46	0.48	0.44	0.58	0.40	0.39	0.57	0.51	0.73	0.66	0.64	0.65	0.70	0.58	0.60
94 Vryburg	0.47	0.70	0.61	0.72	0.62	0.58	0.44	0.57	0.59	0.47	0.38	0.49	0.37	0.50	0.70	0.49	0.44	0.66	0.46	0.53
95 Wolmaranstad	0.55	0.66	0.56	0.82	0.63	0.65	0.50	0.62	0.59	0.55	0.41	0.50	0.43	0.63	0.76	0.57	0.65	0.71	0.53	0.58

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

81 Brits	0.57	0.56	0.35	0.67	0.62	0.45	0.53	0.50	0.45	0.47	0.55	0.50	0.46	0.49	0.53	0.57	0.62	0.52	0.53	0.76
82 Christiana	0.69	0.52	0.74	0.53	0.50	0.49	0.70	0.57	0.65	0.67	0.38	0.51	0.64	0.77	0.73	0.30	0.46	0.48	0.37	0.53
83 Coligny	0.52	0.58	0.58	0.49	0.45	0.29	0.50	0.49	0.59	0.55	0.29	0.66	0.55	0.68	0.68	0.31	0.51	0.41	0.41	0.63
84 Delareyville	0.55	0.57	0.62	0.42	0.51	0.43	0.63	0.64	0.57	0.72	0.33	0.66	0.58	0.73	0.65	0.15	0.42	0.56	0.47	0.57
85 Klerksdorp	0.56	0.76	0.53	0.59	0.52	0.47	0.59	0.62	0.73	0.69	0.39	0.70	0.69	0.66	0.63	0.22	0.40	0.46	0.43	0.48
86 Koster	0.58	0.52	0.45	0.52	0.72	0.45	0.64	0.69	0.52	0.58	0.55	0.64	0.53	0.54	0.62	0.48	0.62	0.57	0.62	0.75
87 Lichtenburg	0.51	0.52	0.48	0.39	0.50	0.32	0.57	0.50	0.51	0.65	0.36	0.71	0.55	0.59	0.67	0.20	0.38	0.49	0.49	0.51
88 Marico	0.61	0.53	0.54	0.57	0.72	0.53	0.70	0.57	0.52	0.65	0.54	0.65	0.60	0.57	0.75	0.40	0.46	0.59	0.50	0.72
89 Potchefstroom	0.62	0.69	0.50	0.65	0.60	0.45	0.59	0.48	0.70	0.62	0.49	0.69	0.59	0.58	0.62	0.21	0.43	0.43	0.38	0.51
90 Rustenburg	0.62	0.57	0.54	0.63	0.73	0.52	0.67	0.65	0.56	0.57	0.59	0.61	0.54	0.63	0.64	0.43	0.52	0.56	0.61	0.89
91 Schweizer	0.72	0.63	0.64	0.48	0.45	0.50	0.63	0.64	0.61	0.72	0.30	0.67	0.60	0.80	0.69	0.28	0.44	0.56	0.50	0.46
92 Swartruggens	0.50	0.40	0.38	0.50	0.69	0.40	0.56	0.50	0.38	0.58	0.50	0.58	0.55	0.47	0.60	0.40	0.44	0.56	0.48	0.72
93 Ventersruggens	0.57	0.83	0.55	0.62	0.51	0.49	0.51	0.56	0.62	0.57	0.34	0.73	0.57	0.67	0.62	0.43	0.51	0.40	0.42	0.57
94 Vryburg	0.61	0.57	0.62	0.41	0.36	0.49	0.60	0.62	0.51	0.71	0.31	0.54	0.59	0.72	0.68	0.24	0.37	0.49	0.41	0.52
95 Wolmaranstad	0.67	0.63	0.60	0.44	0.47	0.52	0.69	0.69	0.64	0.77	0.38	0.68	0.67	0.81	0.70	0.24	0.38	0.54	0.60	0.50

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
81 Brits	0.73	0.71	0.30	0.73	0.64	0.71	0.73	0.70	0.69	0.33	0.81	0.78	0.73	0.68	0.68	0.71	0.48	0.74	0.58	0.75
82 Christiana	0.41	0.49	0.68	0.34	0.24	0.52	0.39	0.55	0.38	0.09	0.55	0.41	0.34	0.48	0.48	0.49	0.33	0.36	0.47	0.30
83 Coligny	0.55	0.47	0.49	0.46	0.37	0.55	0.50	0.54	0.50	0.22	0.63	0.46	0.46	0.59	0.59	0.56	0.29	0.39	0.43	0.44
84 Delareyville	0.43	0.48	0.58	0.45	0.36	0.56	0.47	0.54	0.48	0.12	0.52	0.43	0.45	0.57	0.57	0.55	0.27	0.34	0.30	0.40
85 Klerksdorp	0.48	0.42	0.45	0.48	0.27	0.63	0.62	0.54	0.54	0.25	0.58	0.55	0.48	0.59	0.59	0.59	0.12	0.40	0.32	0.47
86 Koster	0.68	0.69	0.46	0.75	0.70	0.72	0.66	0.80	0.71	0.42	0.67	0.73	0.75	0.69	0.69	0.78	0.53	0.65	0.51	0.74
87 Lichtenburg	0.40	0.46	0.36	0.48	0.44	0.47	0.40	0.54	0.48	0.21	0.41	0.36	0.48	0.56	0.56	0.54	0.28	0.27	0.20	0.42
88 Marico	0.59	0.72	0.59	0.70	0.63	0.73	0.70	0.73	0.69	0.29	0.65	0.65	0.70	0.76	0.76	0.79	0.53	0.65	0.54	0.65
89 Potchefstroom	0.51	0.43	0.40	0.48	0.36	0.66	0.60	0.59	0.54	0.28	0.60	0.53	0.48	0.70	0.70	0.60	0.20	0.47	0.41	0.48
90 Rustenburg	0.75	0.77	0.53	0.72	0.63	0.72	0.71	0.74	0.65	0.37	0.77	0.69	0.72	0.73	0.73	0.69	0.39	0.66	0.59	0.68
91 Schweizer	0.41	0.43	0.60	0.35	0.22	0.54	0.40	0.49	0.43	0.14	0.55	0.39	0.35	0.51	0.51	0.52	0.20	0.31	0.40	0.31
92 Swartruggens	0.61	0.73	0.43	0.78	0.69	0.75	0.67	0.75	0.70	0.27	0.68	0.67	0.78	0.69	0.69	0.80	0.58	0.61	0.52	0.70
93 Ventersruggens	0.56	0.47	0.52	0.44	0.25	0.71	0.63	0.54	0.58	0.32	0.56	0.52	0.44	0.67	0.67	0.57	0.19	0.47	0.39	0.43
94 Vryburg	0.37	0.47	0.63	0.32	0.17	0.50	0.43	0.46	0.34	0.10	0.49	0.36	0.32	0.43	0.43	0.45	0.15	0.23	0.29	0.26
95 Wolmaranstad	0.40	0.42	0.57	0.42	0.28	0.56	0.45	0.52	0.45	0.21	0.48	0.37	0.42	0.56	0.56	0.52	0.23	0.31	0.37	0.35
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81 Brits	0.68	0.61	0.65	0.63	0.66	0.32	0.65	0.44	0.50	0.68	0.37	0.18	0.18	0.25	0.31	0.38	0.33	0.51	0.36	0.41
82 Christiana	0.37	0.30	0.32	0.24	0.39	0.22	0.44	0.30	0.41	0.29	0.42	0.23	0.23	0.18	0.28	0.23	0.35	0.30	0.33	0.77
83 Coligny	0.33	0.39	0.35	0.26	0.33	0.26	0.47	0.20	0.34	0.43	0.26	0.18	0.18	0.23	0.24	0.20	0.11	0.24	0.15	0.61
84 Delareyville	0.34	0.26	0.34	0.20	0.27	0.17	0.33	0.24	0.38	0.28	0.42	0.18	0.18	0.18	0.32	0.17	0.44	0.29	0.34	0.69
85 Klerksdorp	0.36	0.37	0.42	0.37	0.29	0.13	0.45	0.34	0.51	0.26	0.41	0.27	0.27	0.18	0.33	0.16	0.29	0.43	0.18	0.56
86 Koster	0.65	0.55	0.59	0.53	0.54	0.33	0.60	0.41	0.46	0.56	0.53	0.08	0.08	0.27	0.56	0.45	0.39	0.49	0.35	0.57
87 Lichtenburg	0.24	0.27	0.26	0.25	0.24	0.08	0.35	0.19	0.23	0.33	0.35	0.27	0.27	0.08	0.30	0.24	0.19	0.31	0.21	0.49
88 Marico	0.62	0.54	0.60	0.46	0.54	0.22	0.58	0.41	0.47	0.53	0.44	0.27	0.27	0.27	0.52	0.35	0.34	0.44	0.37	0.64

89 Potchefstroom	0.46	0.35	0.42	0.35	0.32	0.13	0.57	0.44	0.56	0.44	0.40	0.18	0.18	0.27	0.46	0.27	0.27	0.44	0.27	0.53
90 Rustenburg	0.61	0.54	0.52	0.48	0.59	0.34	0.60	0.33	0.44	0.61	0.47	0.24	0.24	0.18	0.45	0.37	0.35	0.49	0.34	0.49
91 Schweizer	0.33	0.13	0.21	0.15	0.24	0.34	0.37	0.25	0.40	0.27	0.33	0.29	0.29	0.24	0.37	0.16	0.32	0.31	0.29	0.76
92 Swartruggens	0.60	0.60	0.59	0.51	0.55	0.26	0.56	0.39	0.39	0.53	0.42	0.33	0.33	0.29	0.49	0.39	0.40	0.42	0.39	0.61
93 Ventersruggens	0.42	0.31	0.41	0.34	0.38	0.14	0.52	0.30	0.53	0.40	0.39	0.13	0.13	0.33	0.42	0.10	0.18	0.43	0.11	0.48
94 Vryburg	0.24	0.21	0.17	0.08	0.17	0.16	0.31	0.12	0.29	0.13	0.22	0.19	0.19	0.13	0.22	0.00	0.22	0.22	0.19	0.71
95 Wolmaranstad	0.32	0.23	0.28	0.23	0.25	0.23	0.44	0.27	0.37	0.25	0.41	0.00	0.00	0.19	0.31	0.19	0.27	0.26	0.24	0.70

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95

81 Brits	1.00																			
82 Christiana	0.49	1.00																		
83 Coligny	0.67	0.60	1.00																	
84 Delareyville	0.47	0.71	0.66	1.00																
85 Klerksdorp	0.63	0.58	0.75	0.70	1.00															
86 Koster	0.71	0.50	0.64	0.68	0.59	1.00														
87 Lichtenburg	0.56	0.43	0.68	0.67	0.63	0.65	1.00													
88 Marico	0.69	0.58	0.69	0.67	0.62	0.84	0.74	1.00												
89 Potchefstroom	0.63	0.48	0.69	0.53	0.81	0.58	0.66	0.68	1.00											
90 Rustenburg	0.76	0.59	0.71	0.63	0.62	0.79	0.61	0.81	0.63	1.00										
91 Schweizer	0.44	0.81	0.64	0.75	0.63	0.58	0.52	0.61	0.54	0.58	1.00									
92 Swartruggens	0.70	0.48	0.63	0.64	0.58	0.86	0.71	0.91	0.60	0.75	0.52	1.00								
93 Ventersruggens	0.63	0.51	0.72	0.52	0.78	0.61	0.60	0.66	0.80	0.65	0.60	0.55	1.00							
94 Vryburg	0.43	0.78	0.63	0.82	0.58	0.54	0.53	0.63	0.47	0.62	0.81	0.56	0.53	1.00						
95 Wolmaranstad	0.45	0.69	0.71	0.80	0.74	0.60	0.63	0.64	0.61	0.60	0.84	0.57	0.63	0.78	1.00					