

# Effect of government intervention through quality restrictions on the wheat industry in South Africa

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Sub-theme

South African Agricultural Policy

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**ARC • LNR**

*Excellence in Research and Development*

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# Introduction...

- Wheat is South Africa's second most important grain crop and is produced mainly for human consumption, with lower quality going for industrial use and animal feed.
- With a rising middle income population, wheat has become an important element in national food security with a consumption increase of approximately 32% (1999 – 2014).
- Consumption of bread per annum is estimated at 2.8 billion loaves per year (62 loaves/person annually).
- Wheat is produced in three regions; winter, and summer rainfall and irrigation regions
- Generally, the country is a net importer of wheat.



# ...Introduction...

## South African Wheat Production Vs Consumption

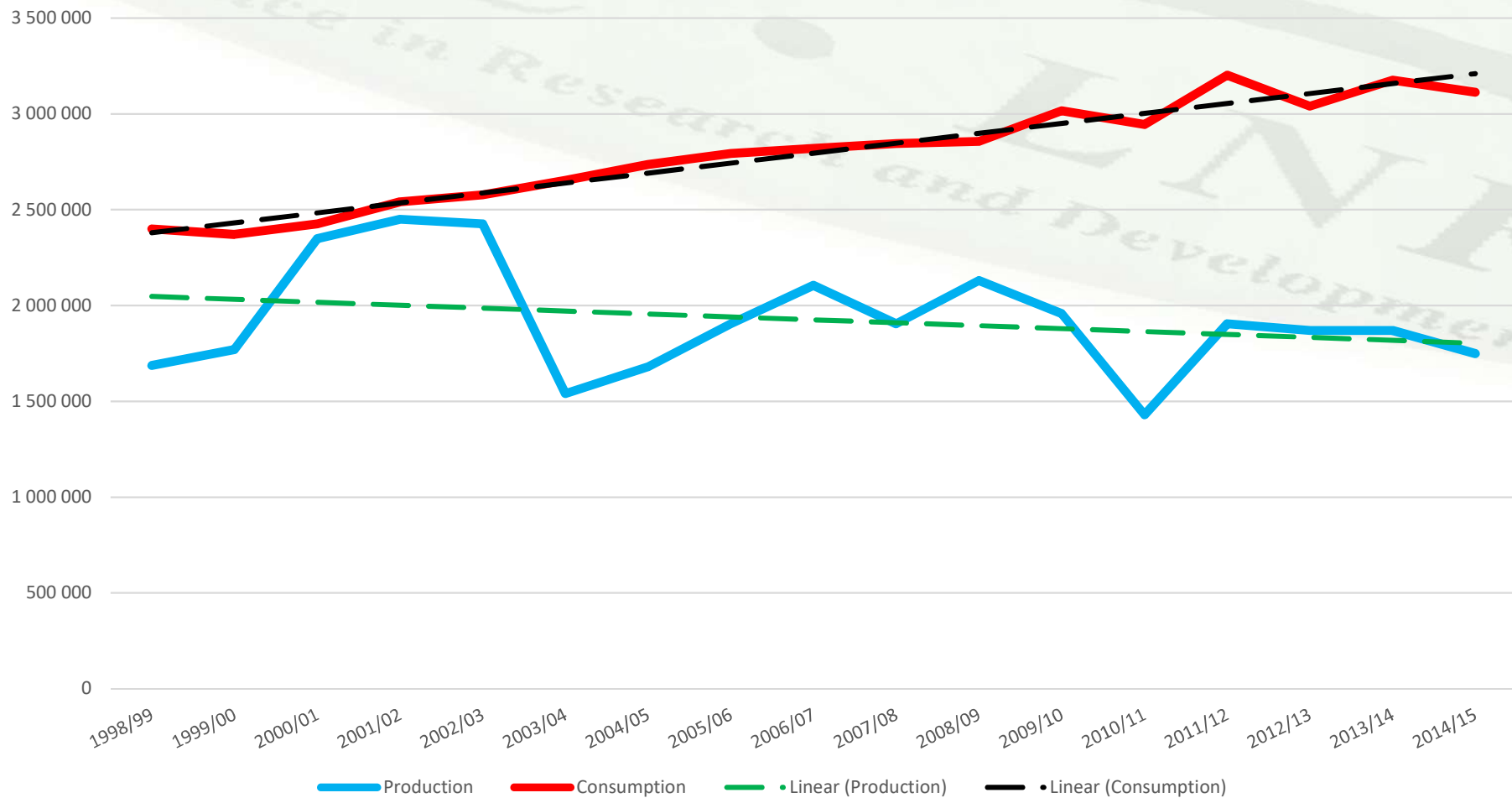


Figure 1: South African wheat production Vs Consumption  
Source: SAGIS



## ...Introduction...

- The country has wheat quality requirements that are believed to have stifled growth of wheat production.
- There is an inverse relationship between wheat quality and yields.
- Quality is a subjective concept, however, there are measurable attributes that rise utility to the consumer.
- The most important quality attributes that traders look at are protein content and hectoliter mass.



# ...Introduction...

Table 1: South Africa's quality standards vs international quality standards

Quality indicator	Minimum requirement by country			
	South Africa	United States of America	Australia	Canada
Hectolitre mass	70 kg/hl	62.5 kg/hl	-	65 kg/hl
Protein content	10.5 %	-	9.5 %	9.5 %

Source: Blakeney et al. (2009); CGC (2016); SAGL (2014); USDA (2014)





## Aim

To show the economic impact of the stringent wheat quality standards that existed in the Agricultural Product Standards Act No. 119 of 1990 (APS) from 1999 to 2014.



# Materials

- Data on **wheat prices** and **total area planted** to wheat between 1998 and 2014 was collected from Liebenberg (2013) , South African Grain Information Services (SAGIS), and the Department of Agriculture, Forestry and Fisheries (DAFF).
- **Seed adoption rates** for different wheat cultivars were sourced from the South African Grain Laboratory (SAGL) reports.
- Cultivar performance data (i.e. **yield, protein content, and hectoliter mass**) was collected from the National Cultivar Trials.
- The analysis used **32 574, 30 495, and 32 255** observations of yield, protein content, and hectoliter mass respectively.
- **Thirty-three ARC cultivars** were used that were tested over **316 localities** from 1998 to 2014.



# Procedures...

- To show the economic impact of the stringent wheat quality standards the study followed three steps
  - Firstly, **genetic gains and losses** associated with breeding for quality alone had to be calculated using a forward regression (on an annual basis).
  - Secondly, **Inherent costs and benefits** associated with the genetic gains and/or losses were computed on an annual basis.
  - Thirdly, the inherent benefits and costs for each year were used in the calculation of a **benefit-cost ratio**.





# ...Procedures...

## ❖ Forward Regression procedure

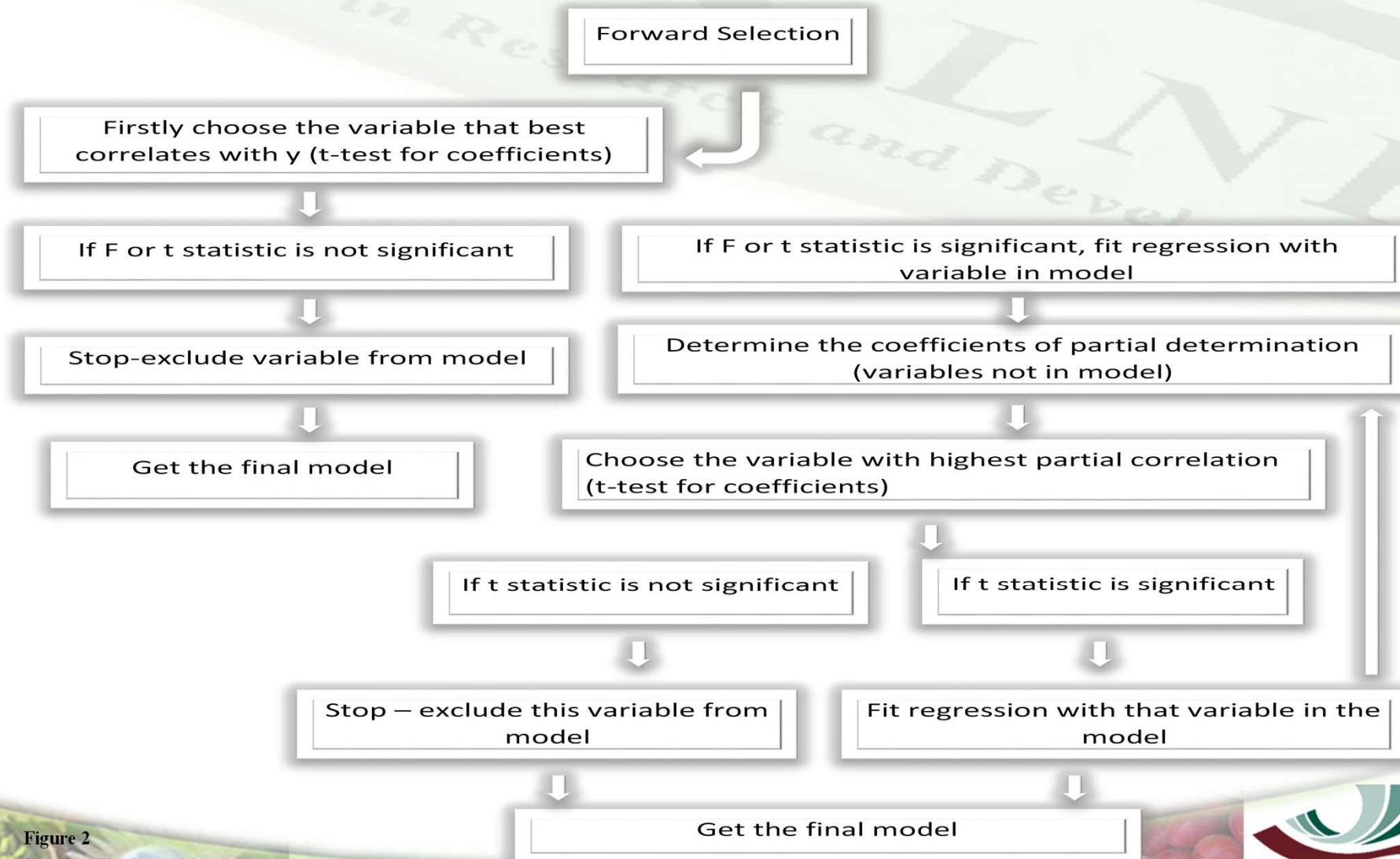


Figure 2  
Source : Thiebaut (2011)

## ...Procedures...

### ❖ Forward Regression

The specific model;

$$Y = \beta_0 + \beta_1 HLM + \beta_2 PC + \mu$$

$Y$  = Yield

$\beta_0$  = Constant

$\beta_1$  = genetic gain/loss from hectolitre mass improvement

$\beta_2$  = genetic gain/loss from protein content improvement

$\mu$  = error.



## ...Procedures...

### ❖ Inherent costs and benefits (monetary losses/gains)

- Hectares planted to ARC cultivars = Hectares under wheat production X Adoption rate of the ARC cultivars
- Tonnage gain/loss =  $\beta_1$  X Hectares planted to ARC cultivars
- Tonnage gain/loss =  $\beta_2$  X Hectares planted to ARC cultivars
- The sign of the coefficient informs on whether there was a gain or loss.
- Inherent costs and benefits = tonnage gains/losses X wheat price



## ...Procedures

### ❖ **Benefit cost ratio**

The benefit-cost ratio formula is given below;

$$BCR = \frac{\sum_{t=0}^T \frac{B}{(1+r)^t}}{\sum_{t=0}^T \frac{C}{(1+r)^t}}$$

Where **B** is the benefits in rands, **C** is the costs in rands, **T** represents the ending year of analysis, **i** is the discount rate, and **t** is the year (time period).

**A benefit-cost ratio above 1 indicates the profitability of a project while a value below 1 shows non-profitability/losses.**



# Results...

## ❖ Winter rainfall region

Table 1: Winter rainfall region regression results, tonnage gains/losses, and benefit cost analysis loss, 1999 to 2014

Winter rainfall region									
Year	South African Hectares Harvested to Wheat	% of ARC cultivars	Hectolitre Mass Influence	Protein Content Influence	Tonnage Gain	Tonnage Loss	Wheat Prices (R/t) 2010=100	Benefits (R) 2010=100	Costs(R) 2010=100
1999/'00	345 500	0,12	0,21***	- 0,18***	8 836	7 830	1708,16	15 093 706	13 375 676
2000/'01	345 000	0,02	-	-	-	-	1961,52	-	-
2001/'02	364 000	0,09	0,10***	0,05***	4 987	-	2192,06	10 931 720	-
2002/'03	325 000	0,09	-	-	-	-	2291,82	-	-
2003/'04	354 000	0,07	-	-	-	-	2051,50	-	-
2004/'05	302 000	0,11	0,07***	-	2 355	-	1518,36	3 575 857	-
2005/'06	292 000	0,19	-0,04***	-0,25***	-	16 117	1373,46	-	22 135 445
2006/'07	325 000	0,19	-	0,27***	16 966	-	1890,77	32 079 684	-
2007/'08	350 000	0,17	0,08***	- 0,23***	4 644	13 574	2786,79	12 942 590	37 828 054
2008/'09	300 000	0,18	0,10***	-	5 656	-	2405,65	13 605 592	-
2009/'10	265 000	0,18	0,12***	-0,14***	5 578	6 540	1607,67	8 967 183	10 514 921
2010/'11	265 000	0,17	0,06***	-0,23***	2 875	10 473	2194,22	6 308 590	22 979 047
2011/'12	272 000	0,15	-	- 0,10***	-	4 043	2136,53	-	8 637 294
2012/'13	310 000	0,11	0,16***	- 0,35***	5 768	12 502	2486,11	14 339 345	31 080 357
2013/'14	310 000	0,07	0,06***	- 0,20***	1 165	4 075	2315,80	2 698 475	9 437 962
<b>TOTAL</b>					<b>58 831</b>	<b>75 154</b>			
<b>Net tonnage loss</b>						<b>16 323,24</b>			
<b>Mean benefits &amp; costs</b>								<b>12 054 274</b>	<b>19 498 595</b>
<b>Mean BCR</b>									<b>0.62</b>

Notes: \*, \*\*, \*\*\* Statistically significant at 90 percent, 95 percent, and 99 percent confidence interval respectively.

Source: DAFF, SAGL, SAGIS, and SAS.



## ...Results...

### ❖ Winter rainfall region

- The pursuit of quality alone has resulted in higher tonnage loss than gains in the winter rainfall region.
- A BCR of 0.62 implies that for every rand invested towards attaining the satisfactory quality standards, 38 cents is lost.
- This suggests that the price premium paid for higher quality wheat is not enough
- Breeding for quality alone in the winter rainfall region is not profitable.



# ...Results...

## ❖ Summer rainfall region

Table 2: Summer rainfall region regression results, tonnage gains/losses, and benefit cost analysis loss, 1999 to 2014.

Summer rainfall region										
Year	South African Hectares Harvested to Wheat	% of ARC cultivars	Hectolitre Mass Influence	Protein Content Influence	Tonnage Gain	Tonnage Loss	Wheat Prices (R/t) 2010=100	Benefits (R) 2010=100	Costs(R) 2010=100	
1999/'00	447 300	0,12	0,23***	-0,12***	12 449	6 625	1 708,16	21 265 398	11 316 790	
2000/'01	502 900	0,02	0,05**	0,10***	1 732	-	1 961,52	3 397 457		
2001/'02	443 500	0,09	-	0,22***	8 846	-	2 192,06	19 392 061		
2002/'03	322 500	0,09	0,09***	-	2 775	-	2 291,82	6 360 041		
2003/'04	356 600	0,07	0,03***	-0,09***	744	2 300	2 051,50	1 525 406	4 718 077	
2004/'05	384 000	0,11	0,03*	-0,16***	1 215	6 684	1 518,36	1 845 216	10 148 069	
2005/'06	362 800	0,19	0,04***	-0,35***	2587	23 990	1 373,46	3 552 581	32 949 885	
2006/'07	218 800	0,19	0,26***	<b>-0,55***</b>	11 146	23 210	1 890,77	21 074 444	43 885 248	
2007/'08	285 500	0,17	0,09***	-0,11***	4 438	5 296	2 786,79	12 367 723	14 759 719	
2008/'09	240 000	0,18	0,09***	-0,17***	3 878	7 755	2 405,65	9 328 939	18 655 744	
2009/'10	208 500	0,18	<b>0,27***</b>	-	9 825	-	1 607,67	15 796 105		
2010/'11	230 000	0,17	0,16***	-	6 392	-	2 194,22	14 025 986		
2011/'12	134 500	0,15	0,05**	-0,05*	975	1 055	2 136,53	2 082 136	2 254 430	
2012/'13	94 500	0,11	0,11***	-0,25***	1 165	2 675	2 486,11	2 896 713	6 649 676	
2013/'14	72 500	0,07	0,20***	0,19***	1 886	-	2 315,80	4 366 958		
<b>TOTAL</b>					<b>70 053</b>	<b>79 590</b>				
<b>Net tonnage loss</b>						<b>9 537</b>				
<b>Mean benefits and costs</b>								<b>9 285 144</b>	<b>16 148 627</b>	
<b>Mean BCR</b>										<b>0.57</b>

Notes: \*, \*\*, \*\*\* Statistically significant at 90 percent, 95 percent, and 99 percent confidence interval respectively.

Source: DAFF, SAGL, SAGIS, and SAS.

## ...Results...

### ❖ Summer rainfall region

- The resulting BCR was 0.57
- This suggests a 43 cent loss from every rand invested towards quality breeding alone.
- Therefore, breeding for quality alone in the summer rainfall region is not profitable.



# ...Results...

## ❖ summer rainfall region

Table 2: Summer rainfall region regression results, tonnage gains/losses, and benefit cost analysis loss, 1999 to 2014.

Irrigation region										
Year	South African Hectares Harvested to Wheat	% of ARC cultivars	Hectolitre Mass Influence	Protein Influence	Content	Tonnage Gain	Tonnage Loss	Wheat Prices (R/t) 2010=100	Benefits 2010=100	(R)Costs(R) 2010=100
1999/00	141 200	0,12		<b>-0,63***</b>			11 055	1 708,16		18 883 535
2000/01	125 600	0,02	0,14***	0,29***		1 278		1 961,52	2 506 688	
2001/02	133 600	0,09	0,04***			541		2 192,06	1 185 611	
2002/03	100 500	0,09	0,23***	-0,60***		2 091	5 509	2 291,82	4 792 801	12 626 467
2003/04	119 400	0,07	0,11***	-0,37***		1 012	3 299	2 051,50	2 077 111	6 768 125
2004/05	119 000	0,11	0,26***	-0,54***		3 236	6 840	1 518,36	4 912 896	10 384 952
2005/06	110 000	0,19	<b>0,33***</b>	-0,47***		6 812	9 601	1 373,46	9 356 379	13 185 935
2006/07	88 200	0,19	0,12***	0,13***		4 240		1 890,77	8 016 622	
2007/08	112 500	0,17	0,24***	-0,20***		4 460	3 786	2 786,79	12 429 590	10 551 806
2008/09	102 500	0,18	0,30***	-0,22***		5 651	4 213	2 405,65	13 595 334	10 134 646
2009/10	84 600	0,18	0,24***	-0,22***		3 561	3 193	1 607,67	5 725 462	5 133 009
2010/11	109 700	0,17	0,14***	-0,13***		2 609	2 399	2 194,22	5 723 847	5 264 176
2011/12	104 700	0,15	0,16***	-0,22***		2 557	3 616	2 136,53	5 463 400	7 725 163
2012/13	101 000	0,11	0,12***	-0,32***		1 428	3 755	2 486,11	3 550 077	9 335 069
2013/14	94 070	0,07	0,24***			1 534		2 315,80	3 552 397	
<b>TOTAL</b>						41 011	57 265			
<b>Net tonnage loss</b>							<b>16 254</b>			
<b>Mean benefits and costs</b>									5 920 587	9 999 353
<b>Mean BCR</b>									<b>0.59</b>	

Notes: \*, \*\*, \*\*\* Statistically significant at 90 percent, 95 percent, and 99 percent confidence interval respectively.  
Source: DAFF, SAGL, SAGIS, and SAS.

## ...Results...

### ❖ Irrigation region

- The resulting BCR from the calculated costs and benefits in the irrigation region was 0.59.
- This implies that for every rand invested towards wheat quality improvement in the irrigation region, 41 cents was lost





## ...Results

### ❖ Aggregate results (South Africa)

Table 3: Aggregate tonnage gain, tonnage loss, and benefit-cost analysis, 1999 to 2014.

	Region			
	Winter rainfall region	Summer rainfall region	Irrigation region	South Africa
<b>Tonnage gain</b>	58 831	70 053	41 011	169 895
<b>Benefits</b>	R12,054,274	R9,285,144	R5,920,586	R27,260,005
<b>Tonnage loss</b>	75 154	79 590	57 265	212 009
<b>Costs</b>	R19,498,594	R16,148,626	R9,999,352	R45,646,573
<b>Net tonnage loss</b>	16 323	9 537	16 254	<b>42 115</b>
<b>Net cost</b>	R7,444,320	R6,863,482	R4,078,766	<b>R18,386,568</b>
<b>Benefit-cost Ratio</b>	0.62	0.57	0.75	<b>0.60</b>

- South Africa has a mean BCR of 0.60.
- This implies that for every rand invested in breeding for quality alone, 40 cents is lost.



# Conclusion and recommendations

- There are more tonnage losses than gains associated with higher quality.
- There are more costs than benefits associated with higher quality.
- Investments made for quality improvement alone are not profitable.
- There is need for the Agricultural Product Standards Act reforms on wheat quality standards to allow for greater wheat outputs.
- Expansion of commercial agriculture through the wheat industry may be enhanced by lowering wheat quality standards



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# Thank You

*This presentation is dedicated to the late Dr Frikkie G Liebenberg.  
Your life lessons live on*

