Agrekon

Agricultural Economics Research, Policy and Practice in Southern Africa

ISSN: 0303-1853 (Print) 2078-0400 (Online) Journal homepage: www.tandfonline.com/journals/ragr20

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AGREKON
2019, VOL. 58, NO. 1, 102–112
https://doi.org/10.1080/03031853.2018.1553721

Economic value of quality restrictions on the wheat industry in South Africa

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ABSTRACT

Wheat is South Africa's second most important grain crop and is produced in winter rainfall, summer rainfall, and irrigation regions. Despite being a net importer of wheat, the country has stringent wheat quality requirements as per the Agricultural Products Act (Act No. 119 of 1990). This paper investigates the effects of the quality requirements in different regions and the wheat industry as whole. Forward regression and benefit–cost analysis were applied to data on wheat area planted, seed adoption rates, prices, and cultivar performance from 1999 to 2016. A total of 31 527 observations from winter, summer and irrigation regions were used, each accounting for 4563, 8824 and 18 140 cases respectively. Forty-nine cultivars were used for trials during this period. Results show that stringent quality requirements have resulted in losses of approximately 39 000 tons from 1999 to 2016. The benefits of pursuing the prevailing quality standards amounted to R400 million while the costs amounted to R514 million, far exceeding the benefits. The resulting benefit–cost ratio was 0.78, implying that for every rand invested in breeding for quality alone, 22 cents is lost. It can be concluded that government intervention through quality standards has led to more losses than gains. In addition, investments made towards quality improvement alone have not been recovered due to the high standards. There are therefore cogent reasons to consider relaxing the quality standards to allow for higher wheat outputs, thus unlocking growth in local wheat production.

ARTICLE HISTORY
Received 14 May 2018
Revised 22 November 2018
Accepted 26 November 2018

KEYWORDS
wheat quality improvement; yield; quality standards; costs; benefits

JEL CLASSIFICATION
C22; D61; Q16

1. Introduction

Wheat is South Africa's most important grain crop after maize. It is produced in three regions, namely, winter rainfall, summer rainfall, and irrigation regions. South Africa is a net importer of wheat. The net imports value of wheat from 1999 to 2016 amounted to about 14 million tons (SAGIS, 2016). Compared with its trade partners, South Africa's wheat quality standards are relatively high (Blakeney *et al.*, 2009; SAGL, 2014; USDA, 2014; CGC, 2016). Formal classification and grading of wheat by quality started with the introduction of the Wheat Board in 1938. At that time the Wheat Board provided fixed prices for the various wheat grades. Although the Wheat Board was abolished as part of the reform of the South African markets towards liberalisation, quality standards are still set by the government as part of the Agricultural Products Act (Act No. 119 of 1990).

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There are similarities in wheat parameters of most countries that test for wheat quality. While it is true that the quality of a product is a subjective matter, characteristics of a product that raise utility can be identified and often measured, such is the case with wheat quality. In South Africa wheat grading is focused on intrinsic, physical, and wholesome characteristics of the grain (Smith, 2000; SAGL, 2010). Before a new wheat cultivar is released, it must show superiority to previous cultivars and has to fulfil primary and secondary criteria requirements. Primary parameters are inflexible and these include protein content, hectolitre mass, falling number, loaf volume, flour colour, flour yield, alveogram dough strength, alveogram stability/distensibility (P/L)-values, mixogram peak time, and farinogram water-absorption (Miles, 2010). Of the primary quality parameters, protein content and hectolitre mass are the most important that traders look for (Loy *et al.*, 2015). Protein content and hectolitre mass show correlation with most quality parameters and are often indicative of other parameters.

South Africa has had many changes in its wheat classification system. During the Wheat Board era, wheat of bread baking quality was categorised into the following classes: A, AP, AS, B, BP, BS, and BL. Classes C, D and class other wheat (COW) were of non-bread baking quality and generally used for biscuits, pastas and animal feed, respectively. Nowadays there is only one main class of wheat, which is of bread baking quality (i.e., class B). Wheat that does not meet the criteria for class B either forms utility grade or is classed as other wheat.

Table 1 shows South Africa's minimum quality requirements for the most sought after primary quality parameters. Grades B1, B2, B3, and B4 are of bread baking quality while the utility grade and class other wheat are often used for animal feed.

Table 2 compares the quality standards of the two most important quality parameters of South Africa and its major import partners (USA, Australia and Canada). Only South Africa and Canada have quality restrictions on both protein content and hectolitre mass. This makes breeding efforts harder and costly for the two countries as they breed for both protein content and hectolitre mass. Furthermore, of the four countries, South Africa has the highest requirement for hectolitre mass. Where protein content requirements are higher than South Africa's, the country has either no hectolitre mass requirement, or the hectolitre mass requirement is much lower than South Africa's.

Previous studies have highlighted the issues around quality standards for wheat in South Africa.

According to van der Merwe (2015), the quality requirements for imported wheat are lower than the requirements for domestically produced wheat, resulting in millers blending imported lower quality wheat, with locally produced wheat. Other studies (Smith, 2000; Booyse 2014) found that there is a high correlation between wheat quality and wheat yields in South Africa.

Table 1. Primary parameter quality standards for most sought after attributes of wheat in South Africa.

	Minimum		
Grade	Hectolitre mass (kg/hl)	Falling number (seconds)	Protein content (percentage)
B1	77	220	12
B2	76	220	11
B3	74	220	10
B4	72	200	9
Utility grade	70	150	8
Class other wheat	< 70	< 150	< 8

Source: SAGL (2014).

Table 2. South Africa's quality standards vs international quality standards.

	Minimum Requirement by country			
Quality variable	South Africa	United States of America	Australia	Canada
Hectolitre mass	70 kg/hl	62.5 kg/hl	–	65 kg/hl
Protein content	9%	–	9.5%	9.5%

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

Stander (2012) identified the economic benefits of wheat breeding in South Africa both attributable to the public and private sectors. While most studies conducted elsewhere (Pardey *et al.*, 2004; Barkley *et al.*, 2008; Nalley, 2008; Nalley *et al.*, 2011) attach certain benefits and costs to an entire breeding programme, none have isolated quality standards adherence as a cost in the calculation of a benefit–cost ratio. The following research questions arise: How much do breeders gain from breeding for quality? How much do breeders lose out when breeding with quality objectives in mind? What impact has government intervention in setting such standards had on wheat outputs and quality? Van der Merwe (2015) found that the costs of high quality standards have led to a net farm income loss of R606 million per annum. This study extends the work of van der Merwe (2015) in an attempt to determine the economic implications associated with adherence to the current quality standards from a public breeding perspective.

Apart from government intervention in the wheat industry through legislation, i.e., Agricultural Product Standards Act (Act No. 119 of 1990), government also plays a role in breeding through funding of the Agricultural Research Council (ARC). The ARC's Small Grains Institute (SGI), which is responsible for public wheat breeding, also considers the quality attributes, in addition to breeding for higher yields.

This study investigated the economic effects of government intervention in the South African wheat industry by quantifying the public breeding tonnage loss or gain and the related monetary costs and benefits associated with abiding to the Agricultural Product Standards Act No. 119 of 1990. The study adds to the existing body of knowledge on the effects of government intervention in pursuing quality standards for wheat in South Africa and the impact on domestic wheat production.

2. Methods and procedures

2.1 Data

The panel data used in the study spanned from 1999 to 2016. The process was influenced by data availability on historical costs. Secondary data were sourced from various sources. Data on wheat prices and total area planted to wheat between 1999 and 2016 was collected from Liebenberg (2013) and the Department of Agriculture, Forestry and Fisheries. Seed adoption rates for different wheat cultivars were sourced from the South African Grain Laboratory reports. Cultivar performance data (i.e., yield, protein content and hectolitre mass) were collected from the National Cultivar Trials administered by the Agricultural Research Council to test the performance of new and old cultivars from both the private and public sector. Given that the study evaluated the economic value of government intervention in the South African wheat industry, only Agricultural Research Cultivars were used in the study. Forty-nine cultivars, tested over 435 localities from 1998 to 2016 were used. The analysis used 33 331, 32 210 and 33 006 observations of yield, protein content, and hectolitre mass respectively. The high number of observations compensate for the low number of years in the study period as these observations improve estimates. A total of 31 527 observations from winter, summer and irrigation regions were used, each accounting for 4563, 8824 and 18 140 cases respectively.

2.2 Methods

Three steps were applied in evaluating the economic implications of the wheat quality standards. Firstly, genetic gains and losses associated with breeding for quality were calculated 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.

To determine the genetic gains and losses associated with the wheat quality standards, a forward regression was used. Forward regression is a best model selection procedure that relies on residuals for fitting the relevant regressors based on significance to the model. A forward regression model starts with no regressors in the model and adds regressors one at a time to the model (SASinst, 2010). In forward regression, first, a regressor that is highly correlated to the dependent variable is chosen. Second, the regressor is fitted into the model (e.g., OLS) to calculate residuals. Third, a variable most correlated with the residuals is added to the model (Thiebaut, 2011). The sequence is repeated until all significant regressors (i.e., lower *p*-value than the critical value) are in the model (JHSPH, undated; SASinst, 2010). The occurrence of subsequent stages of analysis depends on the significance of the regressors at the defined confidence interval. Due to this, only one stage of analysis may occur if only one regressor is found significant.

The two most important quality attributes that traders look for in wheat are hectolitre mass and protein content (Loy *et al*., 2015). Hectolitre mass and protein content are indicative of most other quality attributes (Koen, 2006; Miles, 2010). Some of the key end-use quality traits include the rheological properties of dough or fermentation performance, hardness, grain size and shape, vitreousness and colour (Tadesse *et al*., 2015). Consequently, to limit multi-collinearity problems, only the two most important quality attribute variables were used in the model. The regression was run for each wheat production region on a yearly basis from 1999 to 2016. By so doing, the effects of state intervention were calculated at regional level and then aggregated to national level. The sign of the hectolitre mass and protein content coefficients in each year indicates whether the influence of quality standards were positive (tonnage gain) or negative (tonnage loss).

The specific model is as follows;

$$Y_{it} = \beta_{0j} + \beta_{1t}HLM_t + \beta_{2t}PC_t + \mu_t \tag{1}$$

where Y_{it} represents wheat yields in tons per hectare of cultivar *i* in year *t*; β_0 is a constant; β_{1t} is the genetic gain/loss associated with hectolitre mass improvement in time year *t* and β_{2t} is the genetic gain/loss associated with protein content improvement in year *t*. HLM_t is the hectolitre mass in kg/hl in year *t* and PC_t is the protein content in percentage of 12 per cent moisture basis in year *t*; μ_t is the error term in year *t*, capturing effects of yield improvements outside the model, such as improved cultivation practices.

An estimation of inherent costs and benefits was performed using an adoption of Nalley *et al.* (2008) and Dlamini *et al.* (2017) calculation of benefits from genetic improvements. The steps are shown below:

- Firstly, the number of hectares planted to ARC varieties was calculated by multiplying the total number of hectares under wheat production in the specific region by the estimated adoption rate of ARC cultivars.
- Secondly, the tonnage gains and losses are calculated. The tonnage gains and losses were calculated by multiplying the regression coefficients to the hectares planted to ARC cultivars. If the regression result of β_1 or β_2 is a positive coefficient then it adds to tonnage gains. If the result is a negative coefficient, it adds to tonnage losses.
- Thirdly, the inherent costs and benefits were calculated by multiplying tonnage losses and tonnage gains by wheat prices (discounted to 2010 prices) respectively.

The benefit–cost ratio (BCR) was calculated on the mean benefits and costs that arose while breeding under the quality standards set from 1999 to 2016. Costs and benefits were discounted to 2010 prices. The BCR formula is given below:

$$BCR = \sum\nolimits_{t=0}^{T} \frac{B}{(1+r)^t} / \sum\nolimits_{t=0}^{T} \frac{C}{(1+r)^t} \tag{6}$$

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

A BCR above 1 indicates the profitability of a project while a value below 1 shows non-profitability/losses (Asaduzzaman *et al.*, 2011). In this study, a BCR above 1 indicates a positive return on investment from pursuing the current quality standards, while a BCR below 1 indicates losses on investment from pursuing the current quality standards.

3. Results and discussions

One of the general characteristics of wheat is the defect of conversion, that is, yield declines as quality improves (Karaman *et al.*, 2008 cited in van der Merwe, 2015). Hence, the quality attributes of wheat in South Africa are considered to be of great importance as they are also considered during wheat prices determination (Karaman *et al.*, 2008). In their study, Stiegert and Blanc (1997) conclude that marketing wheat at the highest possible prices and volumes may depend critically on developing the desired quality characteristics. This becomes one of the objectives of the wheat quality improvement programme in South Africa. The regression results regarding the relationships between wheat yields and quality as per the Agricultural Product Standards Act No. 119 of 1990 are presented and discussed below.

Tables 3, 4 and 5 below show the positive relationships between hectolitre mass and yields, while negative relationships are depicted between protein content and yields. Negative relationships can be linked to the fact that protein content is arguably the single most important characteristic of wheat used to gauge the end-use performance of a specific sample of wheat as higher percentages are often associated with better quality (Mailhot & Patton, 1988). The negative correlations between wheat yields and protein content have also been recorded in studies by Fossati *et al.* (2010) and Smith (2000).

In the winter region, the highest correlation between hectolitre mass and yield was in the 1999/00 season where an increase of one kg/hl led to a 0.21 ton increase in yields, while the highest correlation of protein content to yields was in the 2012/2013 season. This implies that a one percentage increase in protein content (12 per cent moisture basis) led to a 0.35 ton decrease in yields. As a result, there was an estimated net tonnage loss of about 31 000 tons during this period in the winter region. Also shown in Table 3 is a BCR of 0.68, suggesting that South Africa lost 32 cents for every rand invested towards attaining the satisfactory quality standards in the winter region.

In the summer region, the highest hectolitre mass and yield relationship had a coefficient of 0.27 during the 2009/10 season, implying that a one kg/hl increase in grain quality led to a 0.27 ton per hectare increase in yield. The highest yield to protein content relationship was in the 2006/2007 season with a coefficient of −0.55, implying that a one percentage increase in protein content (12 per cent moisture basis) led to a decline of 0.55 ton/ha. This led to an approximate net loss of 15 000 tons in the summer region. A BCR of 0.87 suggests a 13 cents loss from every rand invested towards quality breeding alone in the summer region during the period under consideration.

In the irrigation region, the highest hectolitre mass to yield relationship had an estimated coefficient of 0.33 in the 2005/2006 season, implying that an increase in hectolitre mass by 1 kg/hl led to a 0.33 ton/ha increase in wheat yields. The highest protein content and yield relationship was in the 1999/2000 season with a coefficient of −0.63 leading to a 0.63 ton/ha decline in wheat yields due a one decrease in protein content (12 percent moisture basis). The net tonnage loss was about 16 500 in the irrigation region during the period. A BCR of 0.80 implies that for every rand invested towards wheat quality improvement in the irrigation region, 20 cents was lost.

Generally, wheat breeding towards quality improvement in all three regions contributed towards the hectolitre mass in more or less similar magnitude. The summer region performed better than other regions, losing only 13 cents for every rand invested towards breeding for quality improvement, while at the same time recording the least net tonnage losses of 15 000 tons. This is compared to both the winter and irrigation regions losing an average 26 cents for every rand invested, yet recording highest net tonnage losses of between 16 000–31 000 tons. This leads to a decline in wheat

Table 3. Winter rainfall region regression, tonnage gains and loss, and benefit cost analysis results: 1999 to 2016.

				Winter rainfall region						
Year	*N*	Ha harvested to wheat	Adoption rate of	Hectolitre mass influence	Protein content influence	Tonnage gain	Tonnage loss	Wheat prices (R/t) 2010 = 100	Benefits (R) 2010 = 100	Costs (R) 2010 = 100
1999/2000	400	345 500	0.12	0.21***	−0.18***	8707	7463	1708.16	14 872 266	12 747 656
2000/2001	351	345 000	0.02	0.49	−0.43	–	–	1961.52	–	–
2001/2002	369	364 000	0.09	0.10***	0.05***	3276	–	2192.06	7 181 189	–
2002/2003	326	325 000	0.09	0.57	0.27	–	–	2291.82	–	–
2003/2004	310	354 000	0.07	−0.08	−0.09	–	–	2051.50	–	–
2004/2005	357	302 000	0.11	0.07***	0.21	2325	–	1518.36	3 530 794	–
2005/2006	348	292 000	0.19	−0.04***	−0.25***	–	16 089	1373.46	–	22 097 598
2006/2007	221	325 000	0.19	−0.14	0.27***	16 673	–	1890.77	31 523 863	–
2007/2008	420	350 000	0.17	0.08***	−0.23***	4760	13 685	2786.79	13 265 120	38 137 221
2008/2009	340	300 000	0.18	0.10***	0.31	5400	–	2405.65	12 990 510	–
2009/2010	504	265 000	0.18	0.12***	−0.14***	5724	6678	1607.67	9 202 303	10 736 020
2010/2011	278	265 000	0.17	0.06***	−0.23***	2703	10 362	2194.22	5 930 977	22 735 411
2011/2012	184	272 000	0.15	0.45	−0.10***	–	4080	2136.53	–	8 717 042
2012/2013	88	310 000	0.11	0.16***	−0.35***	5456	11 935	2486.11	13 564 216	29 671 723
2013/2014	80	310 000	0.07	0.06***	−0.20***	1302	4340	2315.80	3 015 172	10 050 572
2014/2015	356	305 800	0.11	0.15***	0.26	5046	–	2465.88	12 442 831	–
2015/2016	360	305 500	0.19	0.02***	−0.11***	1161	6385	3086.54	3 583 473	19 707 558
2016/2017	348	315 000	0.12	0.04***	−0.26***	1512	9828	2901.00	4 386 312	28 511 028
Total	**4563**					**60 045**	**90 844**		**139 079 620**	**203 111 830**
		Net loss				**30 799**				
					BCR				**0.68**	

Notes: *, **, ***, statistically significant at 90%, 95%, and 99% confidence intervals respectively.
Source: DAFF, SAGL, SAGIS, and SAS.

Table 4. Summer rainfall region regression, tonnage gains and loss, and benefit cost analysis results: 1999 to 2016.

Summer rainfall region										
Year	*N*	Ha harvested to wheat	Adoption rate	Hectolitre mass influence	Protein content influence	Tonnage gain	Tonnage loss	Wheat prices (R/t) 2010 = 100	Benefits (R) 2010 = 100	Costs (R) 2010 = 100
1999/2000	840	447 300	0.12	0.23***	−0.12***	12 345	6441	1708.16	21 088 055	11 002 464
2000/2001	56	502 900	0.02	0.05**	0.10***	1509	–	1961.52	2 959 345	–
2001/2002	805	443 500	0.09	0.11	0.22***	8781	–	2192.06	19 249 136	–
2002/2003	721	322 500	0.09	0.09***	−0.15	2612	–	2291.82	5 986 807	–
2003/2004	948	356 600	0.07	0.03***	−0.09***	749	2247	2051.50	1 536 286	4 608 859
2004/2005	744	384 000	0.11	0.03*	−0.16***	1267	6758	1518.36	1 924 066	10 261 684
2005/2006	976	362 800	0.19	0.04***	−0.35***	2757	24 126	1373.46	3 787 014	33 136 371
2006/2007	788	218 800	0.19	0.26***	−0.55***	10 809	22 865	1890.77	20 436 804	43 231 700
2007/2008	272	285 500	0.17	0.09***	−0.11***	4368	5339	2786.79	12 173 117	14 878 254
2008/2009	814	240 000	0.18	0.09***	−0.17***	3888	7344	2405.65	9 353 167	17 667 094
2009/2010	700	208 500	0.18	0.27***	−0.08	10 133	–	1607.67	16 290 681	–
2010/2011	187	230 000	0.17	0.16***	0.09	6256	–	2194.22	13 727 040	–
2011/2012	205	134 500	0.15	0.05**	−0.05*	1009	1009	2136.53	2 155 225	2 155 225
2012/2013	176	94 500	0.11	0.11***	−0.25***	1143	2599	2486.11	2 842 742	6 460 778
2013/2014	155	72 500	0.07	0.20***	0.19***	1979	–	2315.80	4 583 547	–
2014/2015	181	40 330	0.11	0.06*	−0.13***	266	576	2465.88	655 924	1 420 347
2015/2016	103	59 653	0.19	0.07***	−0.31***	793	3514	3086.54	2 447 626	10 846 102
2016/2017	153	88 960	0.12	0.21***	−0.45***	2242	4804	2901.00	6 504 042	13 936 404
Total	**8824**					**72 907**	**87 621**		**147 700 624**	**169 605 280**
				Net loss		**14 714**				
					BCR				**0.87**	

Notes: *, **, ***, statistically significant at 90%, 95%, and 99% confidence intervals respectively.
Source: DAFF, SAGL, SAGIS, and SAS.

Table 5. Irrigation region regression, tonnage gains and loss, and benefit cost analysis results: 1999 to 2016.

				Irrigation region						
Year	*N*	Ha harvested to wheat	Adoption rate	Hectolitre mass influence	Protein content influence	Tonnage gain	Tonnage loss	Wheat prices (R/t) 2010 = 100	Benefits (R) 2010 = 100	Costs (R) 2010 = 100
1999/2000	684	141 200	0.12	0.17	−0.63***		10 675	1708.16		18 234 130
2000/2001	520	125 600	0.02	0.14***	0.29***	1080	–	1961.52	2 118 755	–
2001/2002	920	133 600	0.09	0.04***	−0.31	481	–	2192.06	1 054 293	–
2002/2003	1764	100 500	0.09	0.23***	−0.60***	2080	5427	2291.82	4 767 788	12 437 707
2003/2004	1560	119 400	0.07	0.11***	−0.37***	919	3092	2051.50	1 886 108	6 344 182
2004/2005	1145	119 000	0.11	0.26***	−0.54***	3403	7069	1518.36	5 167 586	10 732 679
2005/2006	1428	110 000	0.19	0.33***	−0.47***	6897	9823	1373.46	9 472 754	13 491 498
2006/2007	1288	88 200	0.19	0.12***	0.13***	4190	–	1890.77	7 921 381	–
2007/2008	1052	112 500	0.17	0.24***	−0.20***	4590	3825	2786.79	12 791 366	10 659 472
2008/2009	949	102 500	0.18	0.30***	−0.22***	5535	4059	2405.65	13 315 273	9 764 533
2009/2010	1124	84 600	0.18	0.24***	−0.22***	3655	3350	1607.67	5 875 584	5 385 952
2010/2011	2237	109 700	0.17	0.14***	−0.13***	2611	2424	2194.22	5 728 801	5 319 601
2011/2012	1344	104 700	0.15	0.16***	−0.22***	2513	3455	2136.53	5 368 673	7 381 925
2012/2013	588	101 000	0.11	0.12***	−0.32***	1333	3555	2486.11	3 314 482	8 838 618
2013/2014	544	94 070	0.07	0.24***	−0.27	1580	–	2315.80	3 659 835	–
2014/2015	383	130 440	0.11	0.13***	−0.17***	1865	2439	2465.88	4 599 860.24	6 014 843.54
2015/2016	323	116 997	0.19	0.21***	−0.24***	4668	5335	3086.54	14 408 525.22	16 466 885.97
2016/2017	287	104 405	0.12	0.32***	−0.27***	4009	3383	2901.00	11 630 549.95	9 813 276.52
Total	**18 140**					**51 410**	**67 912**		**113 081 339**	**140 885 303**
				Net loss		**16 502**				
					BCR				**0.80**	

Notes: *, **, ***, statistically significant at 90%, 95%, and 99% confidence intervals respectively.
Source: DAFF, SAGL, SAGIS, and SAS.

Table 6. Aggregated tonnage gain and loss, and benefit-cost analysis: 1999 to 2016.

Tonnage gain	Tonnage loss	Net tonnage loss	Benefits	Costs	Benefit–cost ratio
184 362 ha	246 377 ha	62 015 ha	R 399 861 583	R 513 602 413	0.78

productivity in the producing regions and the country at large, which can be ascribed to certain quality-related characteristics of wheat (Fossati *et al*., 2010).

From an aggregated perspective, Table 6 shows a net tonnage loss approximately of 39 000 tons in the South African commercial wheat industry from 1994 to 2016. The total benefits and costs associated with breeding for quality improvements were about R400 million and R513 million respectively, yielding an aggregated BCR of 0.78. This implies that South Africa lost 22 cents for every rand invested towards quality improvement.

While the current study generally reveals negative returns from breeding investments for quality improvement in South Africa, Stiegert and Blanc (1997) confirm some considerable research efforts showing situations in which the benefits from providing high quality wheat outweigh the costs in several regions worldwide. In such instances, the lower yields associated with higher-quality wheat will be negated by higher prices (van der Merwe, 2015). This therefore makes wheat quality and the demands for such quality essential elements to consider when evaluating factors impacting the profitability and performance of the wheat industry in South Africa. If concerns about stringent quality requirements are not dealt with, wheat yields will continue to suffer in the face of quality improvements, widening the gap between domestic demand and supply. This could be further compounded by the declining total area under wheat experienced in most regions (van der Merwe, 2015).South Africa is already a net importer of wheat and such trends, if not reversed, will mean the country will likely become an even bigger importer of wheat in future.

4. Conclusion

The study aimed to determine the effects of government intervention through quality restrictions in the South African wheat industry, with a focus on the public wheat breeding programme. Using a large data set of more than 30 000 observations, the relationship between yield, hectolitre mass and protein content was estimated for each of the production regions. It was found that government intervention in the wheat industry through quality restriction has led to more costs than gains in all three wheat production regions of South Africa. The findings in this study add to the growing body of literature that shows that the quality standards for wheat in South Africa have had a negative effect on local production by affecting yields realised. It has also been suggested that the high quality standards could have contributed towards observed declines in the area under wheat in the country (van der Merwe, 2015). This paper specifically adds value by quantifying in monetary terms the net gains/losses for public breeding because of the high quality standards in the country. When it is further considered that over the years, there has been an increase in cultivars released by the private sector, with more area being put under these, it can be concluded that the total costs to the economy are much higher than what has been lost through quality restrictions for the public breeding programme alone.

Since government is involved in both breeding and legislation of quality standards, it was expected that public breeding efforts would result in more benefits than costs from the quality standards it sets, meaning that quality standards are not too strict. Any losses could be considered as indication of inefficiency in the breeding techniques of the private sector. However, findings in this study suggest that the state has set quality standards from which its own breeding efforts fail to produce more gains than costs. The quality standards were found to be too high and having adverse effects on wheat production.

Following the findings of the study, it can be concluded that pursuing quality standards leads to lower wheat yields. With lower yields per hectare, farmers would expect lower incomes, a disincentive for farmers to pull out of wheat production in the commercial sector, leading to a further decline in the area dedicated to wheat production. This therefore leads to reduced wheat supply at national level in the face of an increasing population and increased demand. This has potential to exacerbate problems of high food prices and food insecurity. However, lower yields and higher quality situation could lead to higher prices in most instances. The negative effects of lower yields on incomes can be mitigated through higher prices. Yet, in the SA wheat industry, prices are determined by the import parity price and not by standard of quality. Consequently, producers suffer the effects of both lower yields and lower prices, leading to reduced profits. Low profits may also make the wheat commercial sector unattractive to smallholder farmers who can potentially play a bigger role in contributing to national wheat output. To promote growth of the wheat commercial sector there is a need to revisit the wheat quality standards laid out in the Agricultural Product Act No. 119 of 1990.

This study concurs with van der Merwe (2015) advocating less strict quality standards in the wheat industry. Based on the results, it is recommended that current wheat standards be revised. The new quality standards should be demand driven and based on analysis of costs and benefits of alternative quality standards. It is further suggested that these new standards be set such that the benefits of quality improvement, at the very least, cover the costs and ensure that there are positive returns to both public and private wheat breeding efforts in the long-run.

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