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**Transforming Smallholder Agriculture in Africa:  
The Role of Policy and Governance**

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# **Productivity gains from prioritising Research and Development (R&D) investment in agricultural policy: Case of South African cling peach breeding.**

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## ***Abstract***

*Literature is awash with strategies of how the farm productivity of the smallholder agricultural sector can be transformed to equal that of the commercial sector. Policy options that have been suggested to transform smallholder agriculture have centred on increasing state financial investments in areas such as infrastructural development, mechanisation and market access. However, this paper provides a practical demonstration of how prioritising investment in research and development (R&D) can achieve this goal. It particularly focuses on how consistent funding towards breeding can lead to the establishment of a strong industry that can remain productive in face of various changes in the market, production environment and institutional domains. Using the Cost-Benefit variation of the Economic Surplus Approach, the paper shows that the use of new locally bred peach varieties, as opposed to obsolete and imported varieties has yielded benefits estimated to range around R61.2 million (inflation adjusted to 2013 values). The results suggest two conclusions. First, R&D investment plays a pivotal role in enabling agricultural production to remain lucrative through various industry dynamics and will be important in the transformation of the smallholder agricultural sector. Second, increasing research investment can help countries achieve goals of economic growth in the domestic economy as the benefits of breeding investment were found to benefit local producers. Recommendations are made encouraging the prioritisation of R&D investment in all African agricultural industries as locally developed technologies are more likely to address Africa's production problems rather than imported technologies.*

## **1. Introduction**

The African continent has enormous potential, not only to feed itself and eliminate poverty, but also to be a major player in global food markets (NEPAD, 2013; 3). However, low levels of agricultural productivity remain a major constraint to achieving this potential as the sector is dominated by a large number of smallholder farmers whose production fails to efficiently utilise resources. According to Holt-Gimenez, Altieri, and Rosset (2006; 1), Africa's failure to meet its yield targets has been attributed to weaknesses in its production systems such as high reliance on rainfed production, poor infrastructural development, as well as weaknesses in international factors such as limited market access. This paper supports the former view and echoes the argument by Everton and Keslev (1973; 1310) that states "...success of a green revolution depends less on breakthroughs resulting from concentrated international efforts and more on local selection, adaptation, and marginal improvements". The authors argue that perhaps Africa's failure in reaching its food targets could to a large extent be due to the lack of availability of well adapted seed/cultivars which adequately address its production and marketing needs. The paper provides evidence that supports the argument that Africa's lack of improvement in productivity has been as a result of the continent utilising varieties developed in other parts of the world as opposed to developing local varieties that can meet its unique production needs. This argument is put forth by analysing the case of the cling peach breeding programme of South Africa - particularly highlighting how the locally developed varieties have made an impact on improving the farm enterprise productivity,

agro-processing production capacity and product quality, and competitiveness while aiding the industry to adapt in dynamic business environment.

For a long time, Africa has outsourced much of the Science for its agriculture thereby undermining its own capacity to fully mobilise this Science for improving the livelihoods of its people (FARA, 2014; 1). The main factors driving this trend have been the high costs associated with conducting research and the long lag associated with acquiring the return to such investment. Consequently, African governments have continually reduced allocation to research and development despite lessons from Asia and Latin America which have highlighted investment in research and development (R&D) as a key ingredient to the transformation of the agricultural sector (Ehui & Tsigas, 2006; 2). In order to inspire an increase in financial allocation to R&D in Africa, this paper investigates the returns that can be attributed to cultivar development by calculating the welfare gains acquired from yield differential brought about by the adoption of new generations of locally bred improved varieties.

Addressing the policy issue of research investment is also opportune for several reasons. First, decision makers desire information on research payoffs in order to assess alternative uses for public fund as concerns on the productivity of its tax are rising (Norton & Davis, 1981; 687). Second, the private sector has come on board as funding partners of agricultural R&D and is thus pushing for an improvement in funding accountability and transparency. Third, as financial resources are being stretched wide and thin (Thirtle, Townsend, Amandi, Lusigi & Van Zyl, 1998; 612), research programmes, especially seed/cultivar development research programmes are seeing early termination. Therefore, the remaining programmes are threatened with foreclosure unless they prove the continued relevance of their research.

Section 2 briefly describes the cling peach breeding programme highlighting how consistent long term investments in R&D has led to the development of technologies that have made a significant impact on the South African peach canning industry. This discussion will bring an appreciation of the analysis that is central to this study. In Sections 3 and 4, the data and method used for analysing the impact of these research outputs are discuss while Section 5 presents and discusses the results. Section 6 ends by giving the conclusion and lessons learnt.

## **2. The Agricultural Research Council's peach clingstone (cling) breeding programme**

Peach breeding in South Africa was started in 1937 at the Western Province Research Station, a predecessor of the South Africa Agricultural Research Council's Infruitec-Nietvoorbij institute. This was the first publicly funded fruit research station in Africa focusing on, amongst other deciduous fruits, the breeding of clingstone peaches which are mainly used for agro-processing and are also suitable for sale on fresh market. The aim of this breeding programme was to develop new cultivars that would replace poorly adapted and low quality imported peach cultivars (Wenzel, Louw & Bester, 1975; 2). Kakamas, a cultivar that was developed from a mutation on a St Helena cultivar, was the progenitor cultivar. This cultivar was patented in 1932 and became the first intellectual property registered to the

Agricultural Research Council (ARC) as this is the state body responsible for carrying out agricultural research in South Africa.

## 2.1 Impact of Kakamas on farm productivity

Soon after its release, the majority of the area under cling peach production was planted to Kakamas because it had characteristics which made it highly adapted to the South African peach production regions. The most significant characteristic was that it produced high yields. While other imported cultivars that were available at the time performed equally as well under a controlled environment, Kakamas out performed these because it had higher resistance to diseases, pests and droughts (Reinten & Stassen, 2013). The adoption of this “Gift from God” cultivar resulted in the improvement of in cling peach productivity. Table 1 shows that the yield per tree that was experienced at industry level increased from 21 kg as recorded in 1952 to 37 kg in 1964. This increase in yield is attributed to the adoption of Kakamas because by 1964 85% of the trees planted to the sector were planted to Kakamas. According to the 1965 annual report of the Canning Fruit Board, there was a high but steady improvement in productivity of the sector because there was gradual adoption of Kakamas thus industry yield averages progressively changed. The period shown in the table is one that represents the highest change in yield measured per tree in the sector’s history.

**Table 1: Cling peach sector yield improvement: 1952 – 1964.**

Year	Yield per tree (kg)
<b>1952</b>	<b>21</b>
<b>1955-57</b>	<b>30</b>
<b>1964</b>	<b>37</b>

Sources: CFB, (1965).

## 2.2 Impact of improved cultivars on fruit processing productivity

The discovery of Kakamas is described as the foundation of the South African peach canning sector. This is not only because it’s impact on farm productivity made it economically feasible to produce cling peaches at a large scale but also due to the fact that it set the foundation for the breeding of new varieties that would excel in the local production regions. The products of this breeding effort, which will be referred to as Modern Varieties going forward, performed at par with Kakamas in terms of hardiness and yield but outperformed it in areas such as fruit quality which its performance was limited. The first group of these Modern Varieties were released between 1948 and 1959 and these were named Woltemade, Tokane, Keimoes, Du Plessis and Walgant. These cultivars addressed the quality problems faced in the sector as they produced fruit with excellent texture, colour and taste. With an improvement in quality the South African canned products had better chances entering new markets and securing market share. This was particularly important attribute as the canning sector was export orientated.

With time, this first group of Modern Varieties gradually replaced the small share of imported cultivars because they performed better, particularly during the canning process. As

documented in the Fruit and Fruit Technology Research Institute’s 1960 annual research report, the imported cultivars were often too soft and could not be handled by the canning companies’ pitting machines and some would also clog the machines. As a result peach halves were often discarded and canneries faced high losses annually. Therefore, the adoption of these new cultivars led to lower post-harvest losses. Consequently, there were improvements in the return to fixed investment for the canning sector.

### 2.3 Reducing post-harvest losses

All the locally developed cultivars planted up to 1960 were harvested within the first two weeks of February (week 5 and week 6). This presented the industry with problems in fruit handling as millions tonnes of fruit had to be harvested, stored, transported and processed in short space of time before it spoiled. In order to cope with the increasing yields due to productivity gains as well as new industry entrants, the industry increased the infrastructural investments that led to increases in the number of canneries. However, it was soon realised that there was need for new cultivars that would spread the harvest period and enable the staggering of fruit deliveries to the canneries in an effort to reduce the high on- and off-farm post-harvest losses that were being experienced.

The next group of Morden Varieties released in 1961- Oom Sarel, Professor Black, Professor Malherbe and Professor Neethling cultivars - managed to solve this problem as they extended the canning season from being concentrated in just the month of February to cover the period between December and February (from week 51 to week 6). (Hurter, 1978; 7). Table 2, shows how the harvest season has changed between 1933 and 1961 and further shows the names of the main cultivars harvested in the various weeks. By 2012, the breeding programme had managed to produce cultivars that extended the harvest period from week 49 to week 7 by as shown in the table.

**Table 2: Spread of South African cling peach variety harvest season: 1932 – 2012.**

	December				January				February			
	Week 49	Week 50	Week 51	Week 52	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1932									Kakamas			
1961			Oom Sarel	Malherbe		Neethling, Black	Du Plessis	Keimoes	Kakamas, Walgant	Tokane, Woltemade		
2012	Summergold		Oom Sarel, Fiestagold, Oom Sarel	Malherbe, Gold Star, Sandvliet	Keisie, Western Sun	Neethling, Black, Fantasy, Golden Pride	Du Plessis, Supreme, Cascade	Keimoes, Autumn Gold	Walgant, Kakamas	Woltemade, Autumn Crunch	Lunar Gold	

Sources: *FFTRI, (1973), Culdevco, (2012).*

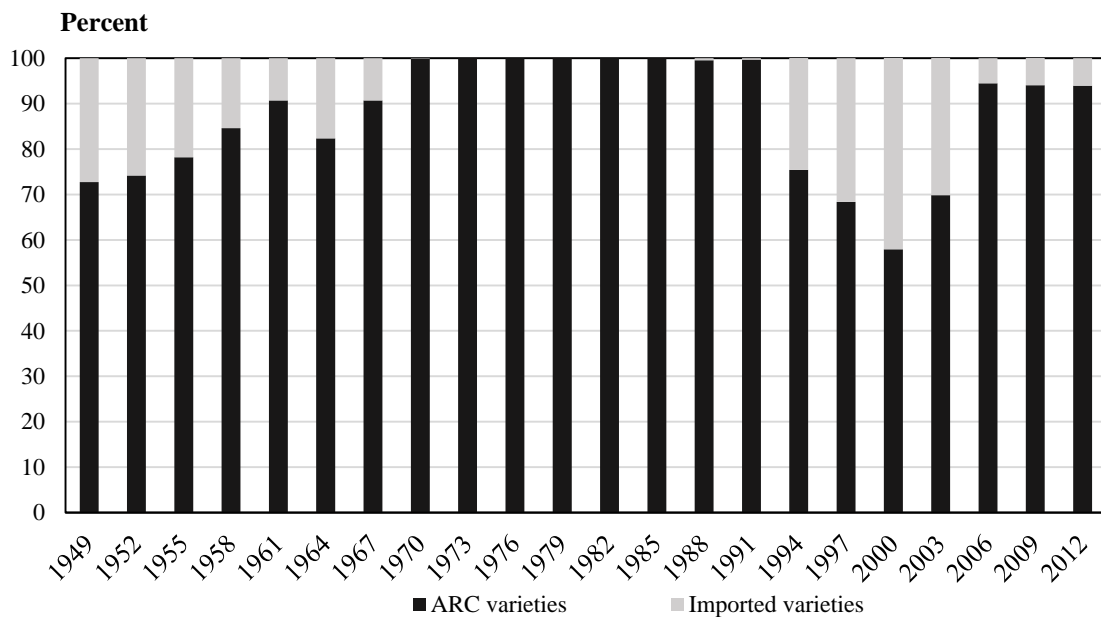
This table illustrates how investments in breeding provided solutions to the problems that inhibited the growth in this sector. The industry experienced technical change as it was able to expand its canning capacity whilst utilising the same resource endowments.

### 2.4 Adapting to a dynamic business environment

Figure 1 shows the area planted under cling peaches for both locally bred varieties and imported varieties during the period between 1949 and 2012. The graph shows that the former were well received by the farmers in the industry as the area planted to ARC-bred cultivars increased from 72% to 100% between 1949 and 1970. The ARC’s breeding

programme's products dominated the market until 1988 when the business environment started to change. Markets were deregulated and trade was liberalised and this led to the removal of protection policies and the lifting of trade sanctions against South Africa. As these trade barriers had been removed, the country became more integrated in global economy and was now open to new markets with different preferences (Vink, 1999; 109). It also had access to improved imported varieties which were reported to better meet the consumer preferences in these new markets. As result, the area planted under ARC-bred cultivars declined as the industry tried to cater for the changes in business environment.

As shown in Figure 1, the area planted to ARC-bred cultivars declined to 74% in 1994. The biggest change was experienced after 1997 when Deciduous Fruit Board which acted as the sole supplier of market intelligence and director of production systems was disbanded. This saw a significant increase in the number of cultivars brought into production as the open market promoted the influx of information and technologies. The area planted ARC bred cultivars reached a low of 59% in 2000. However, due to the better performance of ARC-bred cultivars at farm level, in terms of adaptability and consequently yield, the use of these cultivars again increased after 2003.



**Figure 1: Share of area planted to different cling peach varieties, 1949–2012.**  
*Sources: CFB (1949–1988); HORTGRO (1989–2014).*

Note that the regaining of market share was not only due to farmers reverting back to planting old cultivars but also due to adoption of the newly released ARC's cultivars as shown in Table 3. The table gives an account of the percentage of area planted to the different cultivars as a share of the area planted to ARC-bred cultivars and shows that there was a gradual replacement of the older cultivars by the new cultivars. For example the area planted to Kakamas has decreased by 75% since the adoption of the Modern Varieties such as Professor Black and Walgant. As shown, cultivars such as Bonnigold and Cascade which were bred in 1991 gradually gained market share toward the end of the period under consideration. One



also notices the long lag that exists between cultivar development as illustrated by these two cultivars as these have taken about 20 years to start making a significant contribution to production. Therefore, research investments should not necessarily be motivated by short term returns to investment as benefits take time to be realised. As shown here, some research outputs are useful to mitigate the effects of market shocks thus R&D investment should also be viewed as safety nets that enable an industry to cope with the demands of a changing environment. Another example testifying to this fact is the development of the white flesh variety, Sandvliet, which is replacing older varieties because it enables the industry to diversify the product of a sector that specialises in yellow-flesh peach production. Thus the adoption of this cultivar has enabled the South African product to be sold in new market segments.

**Table 3: Variety composition of ARC cling peach plantings: 1949 – 2014.**

	1949	1957	1961	1966	1973	1980	1989	1992	1996	2003	2009	2014
Kakamas	99	100	100	52	55	32	28	26	22	22	19	17
Keimoes	1	-	-	27	15	7	2	2	1	-	-	-
Oom Sarel	-	-	-	3	-	13	20	22	22	18	13	12
Prof Malherbe	-	-	-	2	-	7	9	7	7	6	4	3
Prof Neethling	-	-	-	2	13	19	25	28	28	19	12	8
Prof Black	-	-	-	3	9	7	4	3	3	-	-	-
Walgant	-	-	-	4	-	5	2	2	1	-	-	-
Woltemade	-	-	-	7	8	10	10	10	10	5	3	2
Goudmyn	-	-	-	-	-	-	-	-	-	-	2	2
Keisie	-	-	-	-	-	-	-	-	6	16	22	27
Sandvliet	-	-	-	-	-	-	-	-	-	9	11	13
Supreme	-	-	-	-	-	-	-	-	-	5	8	8
Western sun	-	-	-	-	-	-	-	-	-	-	2	4
Cascade	-	-	-	-	-	-	-	-	-	-	2	2
Bonnigold	-	-	-	-	-	-	-	-	-	-	2	2

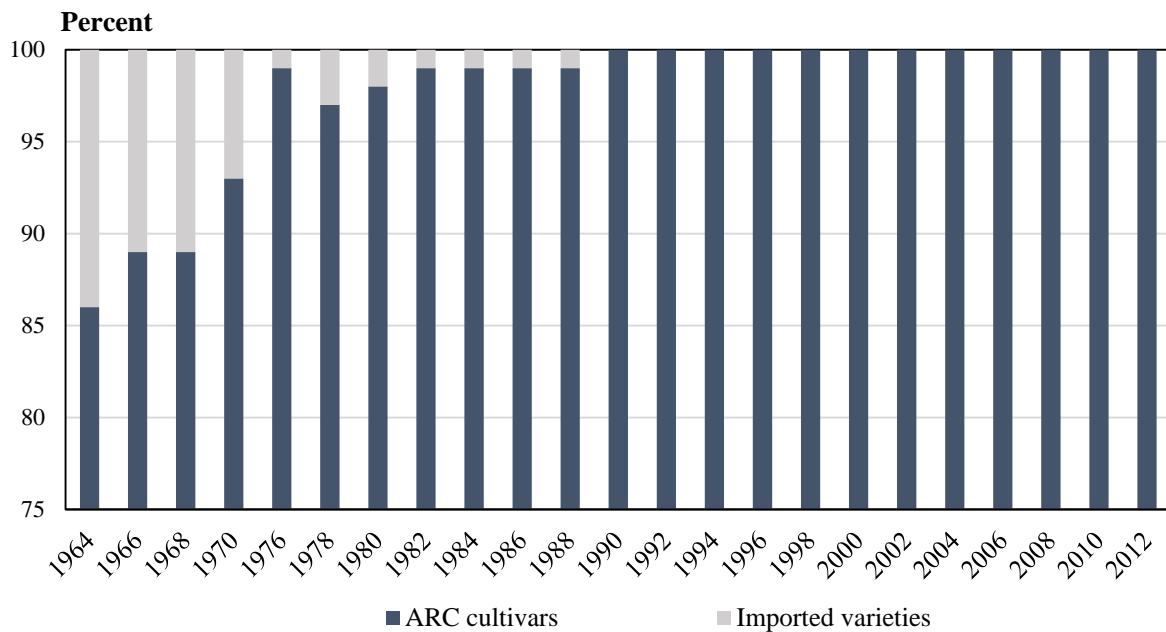
Sources: CFB (1949–1988); HORTGRO (1989–2014)

## 2.5 Influence of research outputs on South Africa’s canning sector’s competitiveness

A country’s industry’s competitiveness is determined by its ability to sell and supply goods and services in a given market, in relation to the ability and performance of other countries in the same market. Though this economic measure is determined by many factors such as trade policy, long term research investment may improve the competitiveness of an industry through influencing the price the product can acquire in the market. The South African canned peaches sector has lost its competitive advantage that made it rank highest amongst other southern Hemisphere countries due to institutional changes resulting in the disbandment of protectionist trade policies. However it has not lost the competitive edge brought by using high quality cultivars. According to Ross (2007; 1), the South Africa fruit processing industry is strongly internationally competitive with respect to costs and absolutely superior with respect to product quality. Cook, Corey, Lynch and Simone (2007, 13) also report that South African canned peaches have a quality advantage that is second to none which enabled it acquire premium prices on the global markets.

South Africa’s quality advantage can be attributed to the use of ARC-bred varieties due the high percentage of the ARC-bred varieties in annual canning deliveries as illustrated in Figure 2 below. As shown, the contribution of the ARC cling peach breeding is very significant as the intakes of ARC-bred cultivars increased from 86 percent of the total fruit

volumes used for canning in 1964 to 100 percent in 1990. The ARC-bred varieties dominated the canning fruit deliveries until 2012 as shown.



**Figure 2: Percentage of ARC-bred varieties of the total used annually in the canning sector, 1964–2014.**

Source: CFB (1964–1988); CFPA (1989–2012).

A closer look at the cultivar composition of canning fruit intakes reveals that the development of new cultivars has contributed to the quality of the South African peach canned product brand. Where Grade 1 represents the classification of the best quality fruit in descending order up till grade 3 fruit, table 4 shows that there has been an improvement in the quality of cultivars used over the years. The table shows that there has been a drift from using cultivars that have been classified as second grade varieties to using cultivars that have been classified as first grade varieties. As shown between the 1964/65 and 1989/90 the percentage of fruit intakes classified as Group 2 cultivars decreased from 85% to 43% while the percentage of Group 1 cultivars increased from 1% to 56%. The contribution of Modern Varieties to quality change is significant because the cultivars which are being referred to as first grade cultivars in the period represented were the newer ARC-bred cultivars Oom Sarel, Prof Malherbe, Prof Black and Prof Neethling whilst older varieties (Kakamas, Keimoes, Walgant and Woltemade) were classified as second grade cultivars.

**Table 4: Variety composition of canning intakes: 1964/65 – 1989/90**

	Group 1 cultivars	Group 2 cultivars	Group 3 cultivars
1964/65	1	85	14
1967/68	6	83	11
1969/70	16	77	7
1977/78	39	59	2
1979/80	50	49	1
1983/84	59	40	1
1986/87	56	43	1
1989/90	56	43	1

*Source:* CFB (1964–1988); CFPA (1989–1990).

*Notes:* Group 1 cultivars: Oom Sarel, Prof Malherbe, Prof Black and Prof Neethling  
 Group 2 cultivars: Kakamas, Keimoes, Walgant and Woltemade  
 Group 3 cultivars: Goosen (USA-bred) and others

With further release of cultivars the number of varieties in these categories has changed however due to data limitations further analysis on variety composition could not be done. Nevertheless, recent reports from the Canned Fruit Producers' Association show that the percentage of cultivars classified as first grade canning fruit increased from 94.7% in 1996/97 (CFPA, 1997) to 95.1% in 2013/14 (Wilson, 2014; 15). While cultivars classified in group three have shifted to occupy a negligible part of the peach canning intakes.

## 2.6 Contribution of Modern Varieties to farm productivity

One the most interesting developments that came with the introduction of Modern Varieties was that there was a shift in the way the industry stakeholders viewed productivity. Instead of considering yield per tree, yield measured per hectare was considered. With this new way of thinking, it was realised that that the farming systems implemented in the sector did not fully utilise natural resources such as land. According to French (1958; 36), South African yields averaged between 1.2 and 3.1 tons per acre between 1950 and 1959. This was very low as the other Southern Hemisphere producers such as Argentina had yields which varied between 2.8 and 6.5 tons and the world leading producer, USA, had yields ranging between 9 and 11 tons per acre during the same period. This is to say, although Kakamas had brought an increase in output per tree but production system that had to be implemented to allow these yields to be attained could allow for a low number of trees to be planted per acre (French, 1958; 37). With this new perspective breeders developed the Modern Varieties with the aim of adapting local production to high density plantings. These varieties also had to have dwarfed growth habits and canopies that could be easily manipulated into the modern training systems that came with high density plantings.

With the adoption of Modern Varieties the industry's yield improved significantly. According to Deciduous Fruit Board (1992) the industry average yield per hectare had increased to 20 tonnes by 1992. However, this productivity growth cannot be entirely attributed to cultivar development alone because the introduced production systems required higher input (e.g.

fertiliser) use. The use of higher levels of improved pesticides also meant that on-farm post-harvest losses were reduced. However, it can be argued that without the development of these adapted cultivars, the industry could not make use of these advancements in production systems especially bearing in mind that peach production has shifted from the traditional temperate-cold climate areas into production areas with sub-tropical climates requiring are suitably adapted cultivars. Thus the issue of adaptability has been central to the success of peach production.

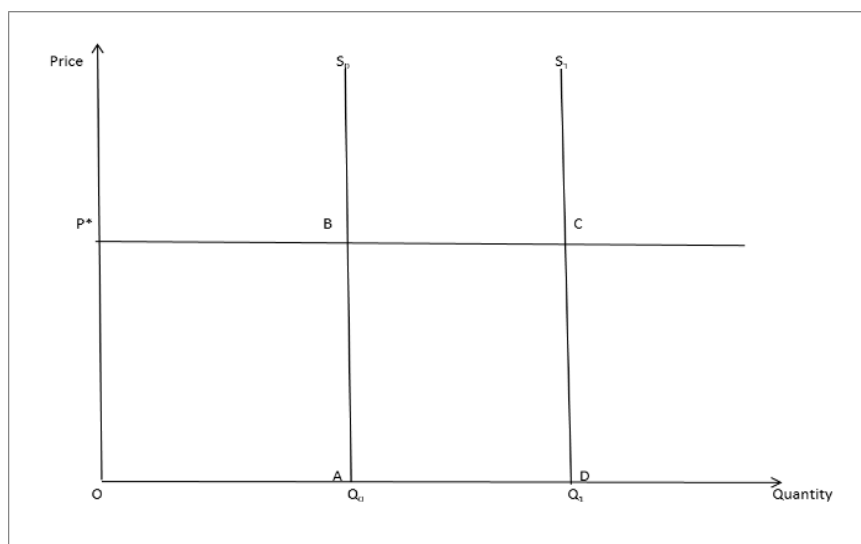
#### **4. Method**

Calculations on returns from agricultural R&D have had a range results ranging from high and positive to low negative values. The wide variation has led to suspicions on the accuracy of these calculations and the reliability types of methods applied. As questions have continued to persist on the accuracy of the reported figures more recent literature has found its roots in the work that was done by Schultz (1953) and Griliches (1958) as cited by Alston, Marra, Pardey and Wyatt (2002). In a bid to avoid the arguments and controversies of the rate of return this paper draws from the work done by Schultz and investigates the monetary returns to R&D breeding investment in the peach canning sector using the Cost Benefit variation of the Economic Surplus approach. One of the advantages of the model is that it is simple to use. Amongst other variations of the Economic Surplus Approach, the Cost-Benefit analysis is a preferred method because unlike the Index Number and Unit Cost Saving this model does not explicitly incorporate elasticities which are often not available at the required level of detail. Another strength of the model is its transparency regarding the data and distributional effects (Anandajayasekeram, Martella & Rukuni, 1996). However, its limitation is that it requires very specific, reliable and consistent data that may not be readily available to the researcher.

The Cost Benefit Approach assumes a perfectly elastic demand curve and a perfectly inelastic supply curve as shown in Figure 3 below. This implies that all welfare benefits to cultivar development accrue to producers. This assumption holds when the following three conditions are satisfied:

1. The producer is a price-taker. The price of the product is not dependent on market power of an individual supplier such that a player in the market could influence the price.
2. The approach assumes the technical change does not change the status of the country from being a net importer/exporter of that specific product.
3. The approach assumes that fixed inputs are almost fully employed and the commodity under evaluation is the principal user of these resources.

These assumptions hold in the case of the processed peach industry because market price in this industry has been determined by institutional arrangements by the interaction of market forces on the open market. In addition the country's net imports have not due to the introduction of ARC-bred cultivars.



**Figure 3: The Cost Benefit Approach to rate of return calculation.**

Source: Anandajayasekeram *et al.*, 1996.

The approach starts off by assuming a state of market equilibrium determined by the interaction of a linear, elastic demand curve and a linear, inelastic supply curve as shown in Figure 3 above. It then assumes that technical change (introduction of improved varieties) causes a rightward parallel shift ( $S_0$  to  $S_1$ ) in the supply curve which creates a new equilibrium point which has a higher quantity ( $Q_1$ ). As the technology is used by price takers, use of the technology only increases the quantity produced while the price remains unaffected by other more significant factors. As the change in quantity produced affects area ABCD depicted under the demand curve, benefits of cultivar development are not divided as producer surplus and consumer surplus but captured by the local industry stakeholders as producer surplus.

The agricultural R&D welfare gains are calculated below:

$$\text{Gross Benefits} = \text{Area } ABCD$$

Area ABCD is calculated as:

$$ABCD = \text{Proportion of area planted to improved varieties} \times \text{Yield gain} \times \text{Price}$$

Where:

$$\text{Yield gain} = \text{Yield of improved varieties} - \text{Yield of existing varieties}$$

## 5. Data

The study used time series data from 1981 to 2013. Although influence of ARC-bred varieties has a history dating much further back in time, consistent data usable in this study could be obtained from 1981. The data on the area planted to the different cultivars were collected from deciduous fruit censuses conducted by HORTGRO and preceding fruit boards.

Annual yields were calculated from fruit volumes delivered to canning and drying reported in the Abstracts of Agricultural Statistics, a journal published Department of Agriculture, Forestry and Fisheries of South Africa. Due to the lack of accurate data showing the exact experimental yield of the cultivars, the average industry yields were used instead. The industry average yield of 1966 was used to estimate the yield of the unimproved variety as Kakamas was the main cultivar in use at this time. During this year, there was very little use of imported varieties and the breeding programme's first cultivars were still being adopted. Due to wide adoption of the ARC-bred cultivars in this industry it was assumed that the industry average yield would be reflective of their performance for the years 1981 to 2013. The price of fruit deliveries for processing were acquired from the Abstracts of Agricultural Statistics. As there was evident difference in the price from the base year and the period under observation, a price differential was used instead of using a fixed price. By so doing, the calculation catered for the effect of R&D investment on the quality as reflected in price. All prices were discounted using a deflator calculated from South Africa's Consumer Price Index. Data for the Consumer Price Index was collected from Quantec.

#### **4. Results and discussion**

The yield gain benefits generated during the period 1981 to 2013 attributed to the use of ARC-bred modern cling peach varieties in the processed fruit industry equal to R61.2 million (in 2013 currency values). These are substantial benefits because the percentage adoption of the Morden Varieties ranged between 50 and 70 of the cling peach production area between 1981 and 2013.

It has been stated that the value attributed to breeding research in general could be an overestimation of the benefits of breeding as adoption of new cultivars often includes the adaption of new production methods (Morris & Heisey, 2003). As certain modern production systems such as trellising systems come with higher fertiliser and pesticide applications which increase yield without changing the cultivar, the argument made by Morris and Heisey (2003) may hold in this case. In addition to the effects of maintenance and adaptive research, other factors that could have influenced yields are: improvement in fuel efficiency, increase in labour productivity due to mechanisation and other infrastructural investments, institutional changes and, improvements in post-harvest handling and logistics (Tsvakirai, 2015; 36). However, it can be argued that that these yield gains are spill overs of the cultivar's adoption as some cultivars were specifically bred in order to take advantage of the new productive production practices. Using the example of the improved trellising systems, old cultivars, Kakamas (to be specific) has weak scaffold branches which makes it unsuitable for use in the modern production systems (FFTRI, 1975; 2). Furthermore South African peach production has shifted into drier and warmer production areas that would not have deemed such enterprises unviable if more adapted cultivars. Therefore, arguably the value calculated in this study is a true reflection of the value of peach clingstone breeding in South Africa for the years 1981 to 2013.

#### **5. Conclusion and lessons**

This paper set out to investigate the gains that a country could achieve from continuing to prioritise research investment. Using the case of South Africa's cling peach breeding, it was

found that locally developed varieties have made an impact on improving the farm enterprise productivity, agro-processing production capacity and product quality, and competitiveness while aiding the industry to adapt in dynamic business environment. However pertaining to productivity gains, there exist a number of factors affecting improvement in yields thus an economic calculation has to be done in order to determine the contribution of investments in cultivar development to the industry's gains. The benefits resulting from the use of Modern Varieties in the fruit processing industry between the period of 1981 and 2013 were calculated using the Cost Benefit variation of the Economic Surplus model. These were estimated to equate to a value of R61.2million (in 2013 currency values). These results mean that, through the use of ARC-bred Morden Varieties the industry has been able to produce goods that have a value of R61.2million (in 2013 currency values) higher than that it would have produced if it had continued using imported varieties or the unimproved variety, Kakamas.

Three important lessons can be drawn from this study. First, investment in research and development is worthwhile because this gives a significantly high welfare gains. This in line with past studies conducted in different parts of the world which have led to a consensus that there is good return agricultural research investment. It is paramount that Africa continues to invest in technology development as agriculture remains a central to its economies. The need to increase research investment is not only highlighted by the possible future gains but by the fact that continuous low levels of funding will lead to unredeemable losses to industry. An increase in investment would help Africa to address its productivity problems as it will be able to produce more food using low or the same resources. This would be critical for Africa as the continent's current population growth trends show higher demand for food in the future. The emergence of alternative ways of utilising land which are different from agriculture as well as alternative processing channels such as biofuel also threaten the future food security thus warrants an increase in the utilisation of resources dedicated to food production.

Second, R&D investment plays a pivotal role in enabling the agricultural sector to remain productive through various industry dynamics. This is an important lesson that has to be taken note of if Africa is to successfully transform smallholder agriculture, especially in light with the undeniable effects of Climate Change on already thin farm profit margins. Given an increase in breeding investment, countries can ensure that a foundation for a wide variety of well adapted crops is developed. In the case of staple crops, this will go a long way to ensuring that a nation is not prone to price changes, and remains food and nutrition secure. For non-staple crops such as fruits, breeding well adapted crops will promote the establishment of high profit enterprises as these crops are classified as high value crops. Growth in such enterprises will be sustained by global consumption trends which indicate future demand increases for high value commodities as consumers earn higher incomes and as consumer health awareness increases.

Lastly, increasing research investment can also help further goals of achieving growth in the domestic economy as the benefits on R&D investment were found to accrue to producers as opposed to being shared between producers and consumers. That is to say, the long run effect

of R&D investment in Africa would be an improvement in the livelihood of the producers which would have positive knock-on effects on rural economies. This paramount for Africa as these widespread benefits would help to address the problems of poverty that stifle the continent's economic development.



## 6. References

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