CHAPTER 5

DISTRIBUTION OF THE ECONOMIC RENT CREATED BY THE INTRODUCTION OF INSECT RESISTENT COTTON

5.1 INTRODUCTION

The distribution of economic rents from a biotechnology innovation has been closely examined for agriculture in developed countries. Moschini and Lapan (1997) stressed the importance of intellectual property rights (IPR) in determining how many of the benefits accrue to input or technology suppliers. Falck-Zepeda, Traxler and Nelson (2000) find that with strong IPR protection in the U.S., 59% of the benefits from the adoption of Bt cotton still goes to U.S. farmers, with only 21% going to the developer and intellectual property holder, the input supplier Monsanto. U.S. consumers get 9%, rest of world consumers 6%, and the supplier of germplasm gets 5%. Pray, Ma, Huang, and Qiao (2001) extend these results to a developing country by showing that with weak IPR protection, Chinese farmers "obtained the major share of benefits" and in particular small farmers benefited greatly.

South Africa is marked by a strong system of IPRs and a dualistic agricultural system with large and small-scale farmers operating under similar, but not the same market access conditions. This chapter describes a wider set of factors that influence the creation and distribution of economic rents from the adoption of Bt cotton in a developing country and builds on earlier work by Huang and Sexton (1996) and Alston, Sexton and Zhang (1997) who showed that imperfectly competitive markets influence the size and distribution of the benefits from research. Depressed world cotton prices also play an important role, which are in turn most likely influenced by subsidies enjoyed by farmers in developed countries. Insurance indemnity payments (particularly in the US) and government program payments (including both export and input subsidies) allow farmers in developed countries to cover their variable operating costs even when prices are low. Overall levels of support for US cotton in the form of direct payments from the US Commodity Credit Corporation typically range from $3 to $4 billion annually. These payments keep world prices from rising as much as they would if supply was allowed to decline more.

As was indicated in Chapters 3 and 4 the story of the introduction of Bt cotton in South Africa began well enough. The technology has been characterised by an impressive adoption rate. Farmers adopt new agricultural technology if the value of increased yield or the value of a decrease in input costs is higher than the extra cost of the technology. Large and small-scale farmers have adopted Bt cotton in South Africa because their income benefits are higher than the additional cost of the technology. The biotechnology companies are in most cases selling their products with the aim of realising maximum profit. The question thus arises: Who gets the greatest share of the income benefits? Who benefits the most?

To analyse the distribution of the income created by the introduction of insect resistant cotton one needs to first understand the structure of the South African (SA) cotton industry. The four major players competing for the spoils of agricultural innovation in South Africa are: the input or technology supplier, the seed or germplasm supplier, the producer who buys inputs and the consumers or the entity buying the agricultural product. These four parties and their share of the economic rent created by the introduction of Bt cotton will be discussed in turn in the next few sections.

5.2 THE INNOVATOR / BIOTECHNOLOGY COMPANY: MONSANTO

When there is only one firm in a market, that firm is very unlikely to take the market price as given. Instead, monopolists usually recognise their influence over the market price and choose a level of price and output that will maximise the overall profits of the firm (Varian, 1996). Intellectual property rights, which have been reasonably well enforced in South Africa, supply investors and innovators with limited monopoly power even in competitive markets and increase their ability to appropriate benefits created by their research effort (Traxler & Falck-Zepeda, 1999). Currently, the technology present in all the genetically engineered cotton varieties available for commercial production in South Africa belongs to one company. Monsanto thus has a monopoly on the supply of the new agricultural biotechnology (trait producing genes). Monsanto acts as a monopolist in setting the technology fee for Bt cotton but the company operates under a price ceiling because there is a maximum effective price level they can charge. If the charged technology fee is too high, farmers can substitute conventional seed for Bt seed and use traditional pest

control methods. As soon as farmers feel that the cost of Bt seed outweighs the benefits they receive, they will stop planting Bt seed and perhaps, as some have indicated, cotton altogether if conventional practices are not profitable either. Figure 5.1 illustrates the share of additional income created by the introduction of the new technology that accrues to Monsanto.

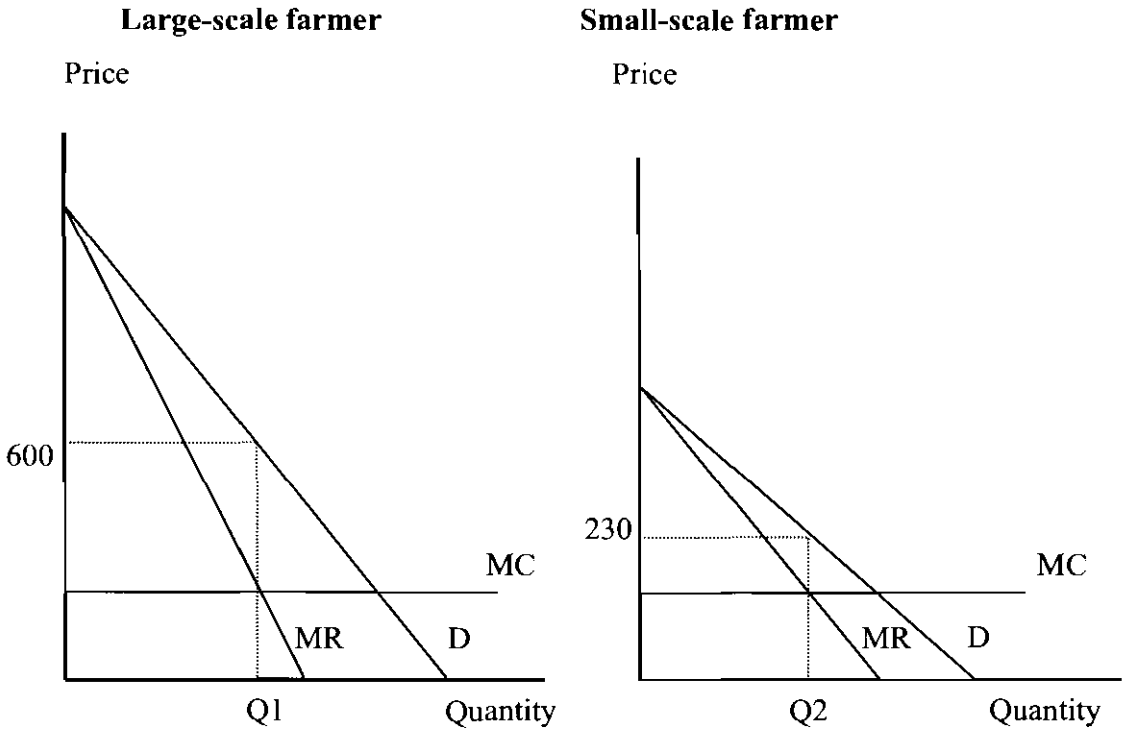

Figure 5.1: Monsanto's share of additional income created by use of Bt cotton

Since a monopolist maximises profit where marginal revenue equals marginal cost the price charged to large-scale farmers (R600, SA Rand) is higher than the seed price charged to small-scale farmers (R230) because of lower input demands and thus lower marginal revenue. Another factor that influences the difference between the two prices is that Monsanto would like to establish a market with small-scale farmers as the small-holder farming conditions are more applicable to the rest of Africa than that of the large-scale farmers. For Monsanto, the marginal cost of producing one extra unit of technology in South Africa is constant, with all the research and product development having already been done in the US. The cost of having a product registered and taken through the SA biosafety protocol and regulatory requirements does not depend on the level of sales of the specific product.

There is thus a constant marginal cost and perfectly elastic supply due to the fact that the technology was on the shelf and there is no additional cost for producing an extra unit of output in the case of Bt cotton seed. The income benefit to Monsanto can thus be calculated with a simple price multiplied by quantity minus marginal cost calculation.

5.3 THE SEED SUPPLIER: DELTA AND PINELAND

The cotton seed company Delta and Pineland (D&PL) has been given the sole right by Monsanto to use the Bt technology in their cotton seed. D&PL charges approximately R25.00 per 25kg bag more for Bt cotton seed than for their conventional varieties. D&PL's share of the additional benefit created is thus also easy to calculate by multiplying the R25.00 by the number of bags sold.

The sole right of distribution and an impressive adoption rate of the Bt technology have caused D&PL's market share in cotton seed sales to increase. An interesting fact is that the seed supplier who lost market share is Clark Cotton, a large ginning company who bad some cotton varieties on the market and in fact had most of the cotton seed market before D&PL started selling cotton seed in SA in 1995. In the 1997/1998 season D&PL introduced two Bt varieties named NuCotton 35B and NuCotton 37B. These two varieties were based on the Acala 90 variety of D&PL and were not initially adopted with great enthusiasm, as the Delta Opal non-Bt variety was very popular at the time. D&PL's market share increased as farmers recognised the benefits of the Bt technology, and when NuOpal (Opal with Bt) was introduced for the 2000/2001 season, D&PL captured a major share of the cotton seed market as can be seen in Figure 5.2. In conversations with surveyed large-scale farmers it appears that after paying R600 per bag of Bt seed to Monsanto, the additional R25 paid to D&PL for the new variety was insignificant.

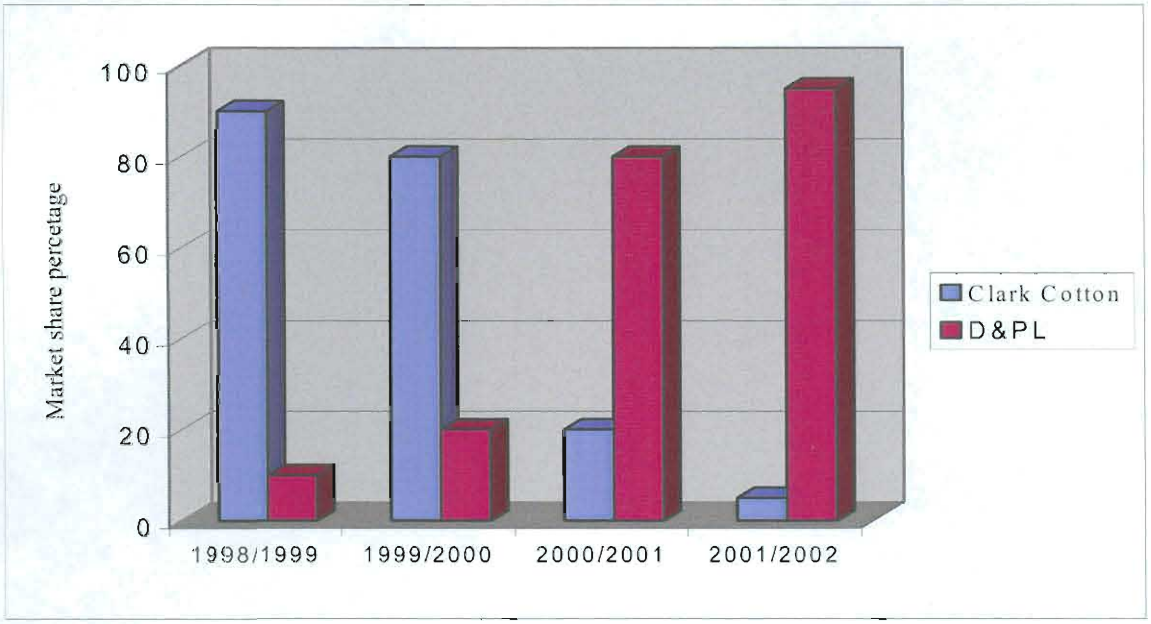

Figure 5.2: Cotton seed market share

Source: Clark Cotton

5.4 COTTON PRODUCERS: LARGE- AND SMALL-SCALE FARMERS

SA cotton producers can be divided into two groups, namely large-scale mainly white cotton farmers that produce under irrigation as well as dry-land conditions and small-scale resource poor, black farmers that produce dry-land cotton.

Not all the benefits enjoyed by producers due to the adoption of Bt technology are straightforward calculations. Yield increases are the main source of additional income for farmers and are easy to calculate. Pesticide savings and reduction in application costs can also be estimated but quantifying labour specifically for pest control is more difficult. Benefits like peace-of-mind and managerial freedom and also health benefits are not easy to measure.

Figure 5.3 shows the SA seed cotton production situation after the introduction of Bt cotton. This SA industry can be classified using the guidelines in Alston, Norton and Pardey (1995) as an importer in a small open economy. The introduction of Bt cotton has caused a parallel outward shift in the supply curves of both large-scale and small-scale cotton farmers due to higher yields per hectare. The size of the respective supply shifts as calculated in Chapter 4 are repeated in Table 5.1 and illustrated in Figure 5.3. The increase in yield for large-scale farmers using irrigation was more than three times that obtained by small-scale farmers. Large-scale dry-land farmers enjoyed the

smallest yield gains. These supply shifts are represented by S3, S2 and S1 respectively in Figure 5.3, where S4 shows the total domestic increase in supply. As there has been an increase in domestic production per area planted, one could expect the amount of cotton imported to decrease from quantity A to B.

Table 5.1: Size of supply shift per hectare

	Q_1 (kilograms per ha with Bt cotton)	Q (kilograms per ha with conventional cotton)	$Q_1 - Q$ (kilograms per hectare)
Large-scale farmers: Irrigation	4 046	3 413	633
Dry-land	947	832	115
Small-scale farmers: Dry-land	576	395	181

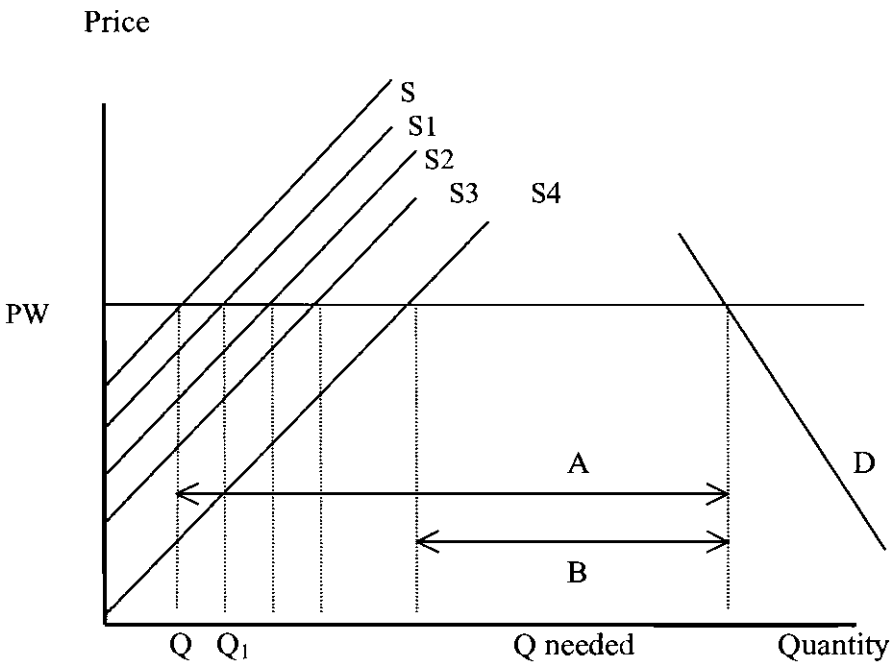

Figure 5.3: The South African seed cotton market - assuming a fixed seasonal area planted

The situation illustrated in Figure 5.3 would have represented the entire story if there had been a constant area planted under cotton in South Africa, but the cotton area has decreased the last couple of seasons mainly due to low cotton-lint world prices. So even though cotton production per hectare increased, total cotton production decreased and the size of cotton imports actually grew. This event and the impact thereof will be discussed later. The benefits of Bt cotton for small-scale and large-scale farmers and the quantitative extent thereof were already discussed in Chapters 3 and 4.

5.5 CONSUMER OR BUYER OF SEED COTTON

5.5.1 THE SOUTH AFRICAN COTTON GIN MILIEU

Seed cotton is an intermediate input in the production of cotton fabrics and other cotton products. As there is no consumer or retail market for seed cotton, the cotton gins as the "producers" of cotton lint, act as the consumers of seed cotton output. In South Africa there are mainly four ginning companies, with Clark Cotton being the largest with a market share estimated to be above 70% (Nolte, 2003). Clark Cotton is owned by AFGRI, formally known as OTK and operates under the name of Vunisa Cotton in KwaZulu Natal and Swaziland. Clark Cotton also has gins in Uganda, Zambia, Malawi and Mozambique.

South Africa is a small player in the world cotton market and has little or no influence on the world seed cotton price. The price paid to farmers by the ginners is derived from the Cotlook A Index, which is accepted worldwide as the indicator of international cotton prices and is the average of the five lowest prices of fourteen styles of cotton traded in northern Europe. But the Cotlook A Index is distorted by production subsidies of large cotton producing countries like the US and China. Subsidies stimulate production of seed cotton, increase supply and thus reduce the world price. The price paid to SA cotton farmers is on average about 30% of the Index in Rand value so when the world price is depressed by subsidies in other countries, the price received by domestic producers also falls.

SA cotton farmers produce about half of the cotton needed in the rather lucrative and expanding SA textile industry. The rest of the country's cotton is imported as seed cotton or as cotton lint from mainly Zimbabwe, Zambia, Mozambique, Botswana,

Namibia and Swaziland. A duty on the importation of cotton lint is in place but due to the fact that South Africa cannot satisfy domestic demand for cotton from domestic production, a rebate of 100% of the import duty is allowed on cotton lint imports by way of a permit system (Calcaterra & Poonyth, 2002). A condition of the rebate is that the SA gins have to first buy the bulk of the domestic production before importing less expensive cotton from abroad.

Cotton production costs in other Southern African countries are lower than in South Africa and farmers are thus willing to accept lower prices for their cotton than SA farmers. It is thought that small-scale cotton farmers in countries like Zambia have higher gross margins than SA farmers, despite the fact that they receive lower prices. In fact, SA cotton farmers (large-scale as well as small-scale) find it difficult to compete with cheap cotton imports from the Southern African Development Community (SADC). According to trade liberalisation procedures of the SADC agreement, import tariffs on cotton were to be abolished at the end of 2003. This means that SA gins will be able to import cotton without any regard for domestic producers. The Cotlook A Index forms the basis of the price at which cotton is imported from SADC and other countries, so SA cotton growers are thus exposed to low prices (partially caused by developed country subsidies) on their own output and substitute imports coming from other SADC cotton growers.

Furthermore it is hypothesized that Clark Cotton acts as a monopsonist in the SA cotton industry. The market share of Clark that is influenced by mainly geographical separation can be used to test this hypothesis. Clark Cotton has a gin in, or very close to each of the cotton producing regions in South Africa. The profitability of ginning becomes marginal when cotton has to be transported over longer distances, so Clark can act as a regional monopsonist when conditions permit.

Clark Cotton (including Vunisa) can therefore set domestic prices at such a level that the quantity delivered at that price will maximise the company's profit. Figure 5.4 illustrates Clark Cotton's monopsonistic market where a constant area of cotton was planted before Bt cotton was introduced. Bt cotton led to an increase in yield per hectare and thus an increase in total domestic cotton production. The volume of cotton Clark had to buy before being able to import less expensive cotton thus

increased and it appears that the introduction of the new technology influenced Clark Cotton's profits negatively.

In Figure 5.4, MC is the marginal cost curve of the monopsonist and S the supply curve of the cotton producer. Pw is the price farmers would have received had they sold their cotton in a competitive market. Because the price, Pm is set by the monopsonist, domestic cotton farmers only produce quantity Qm. The introduction of Bt cotton causes a parallel shift (as assumed previously) in MC to MC1 and from S to S1 and from MC to MC1. Thus a higher quantity is supplied (at every price) and in a big cotton producing country, the monopsonist could have dropped the price to P1 and still received increased output (Qm1). The quantity of seed cotton that SA gins would buy domestically would have increased from Qm to Qm1 because of the technology. With adequate production, S SADC would be the supply curve to SA gins from the other SADC countries producing cotton. Note that farmers in these countries are willing to produce much more (Import Q) at a lower price (Import P), but several factors other than the new technology contribute to cotton supply reductions in South Africa and the surrounding region.

As previously assumed, Figure 5.4 reflects the situation when cotton area is held constant. Because of lower world and import prices, as well as the very high prices obtained for substitute crops like maize and sunflower the last couple of seasons, SA cotton farmers have recently planted less cotton. Even though Bt cotton caused yields per hectare to increase, total production decreased. This may appear to have been beneficial to companies like Clark Cotton because they were able to process less of the "expensive" domestic cotton and import more cheap cotton from other SADC countries. One might expect monopsonists to make excess profits due to their dominant position in the market. Yet, Clark Cotton is buying domestic cotton at a higher price than it would need to pay for imported cotton (Pw instead of Import P). When cotton is imported the Cotlook A index is used as reference in determining the import price but a much lower price is negotiated with the sellers (Calcaterra & Poonyth, 2001 and discussion with Cotton SA).

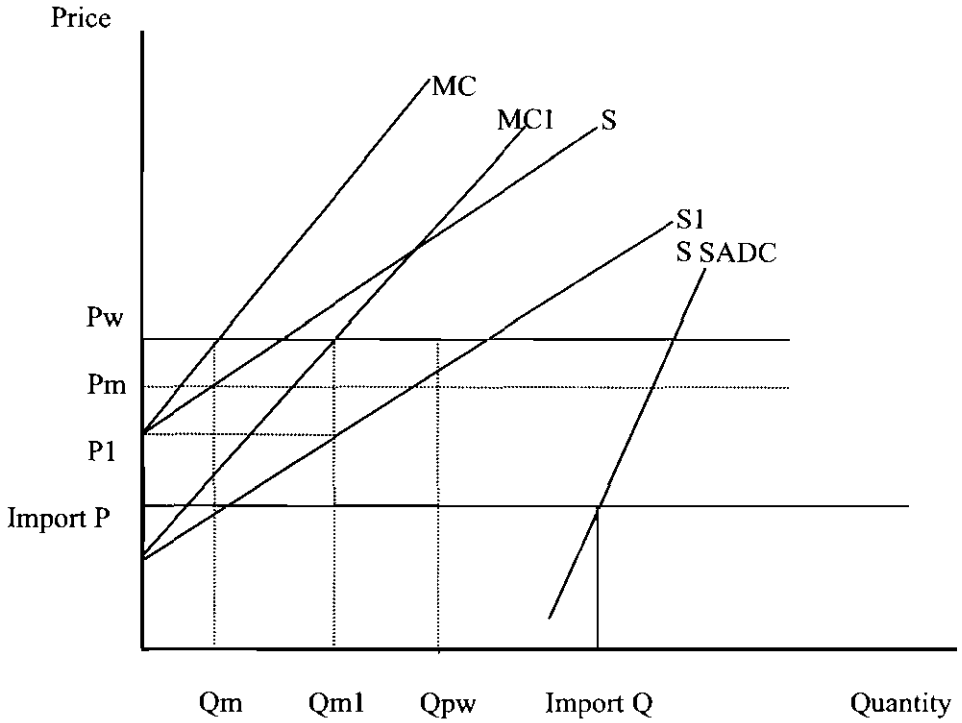

Figure 5.4: Monopsonistic cotton buyer

So why does Clark Cotton buy "expensive" domestic cotton? The reason for this is that even though Clark Cotton would like to import as much inexpensive cotton as possible they do not want to do so at the expense of domestic producers even when they are substituting away from cotton. Cotton gins need to have a consistent supply of cotton to cover their substantial fixed property, plant and equipment expenses. Political instability in countries like Zimbabwe, Zambia and Mozambique and frequent severe weather conditions in the SADC region as a whole, cause gins to be dependent on cotton farmers who can produce more reliably with less production risk – and these are the large-scale irrigation farmers. So even though Clark Cotton can import cotton for less, they have chosen to support the domestic market before venturing outside of SA, so that they can hedge themselves against adverse conditions and events in the import countries. Clark's holding company, AFGRI, used to in fact be a farmer coop (OTK). Clark thus has strong ties to SA cotton farmers through shareholding and also substantial loyalty to their shareholders. Furthermore, Clark Cotton also has cotton gins in Zambia, Malawi and Uganda which have the capacity to process most of the local production except in very good production years.

South Africa's cotton lint imports are nearly double its imports of seed cotton. Inexpensive lint imports are subjected to import tariffs but due to the SADC free trade agreement these tariffs are quickly disappearing. The 2001/2002 season saw yet another drastic decrease in the area planted under cotton in South Africa. The low world price of cotton and the very "persuasive" high price of maize influenced traditional cotton farmers to substitute maize for cotton on an even larger scale than the previous two seasons. With alarming levels of famine in countries bordering on South Africa and a weak SA Rand, maize prices have risen and have reached record nominal levels and it was expected that very little cotton would be planted in the 2002/2003 season. In traditional cotton areas where little cotton is now planted the profitability of the cotton gins has decreased as would be expected with limited supplies of import seed cotton available for processing. In a restructuring of AFGRI, the cotton gin at Modderrivier in the Northern Cape and the gin at Pongola close to the Makhathini flats were temporarily shut down in late 2002 in an effort to cut running costs while the gin in Swaziland was sold. All the domestically produced cotton will now be ginned at the Marblehall gin in Mpumalanga.

Domestically, Clark Cotton is thus struggling and their share of the income from the introduction of Bt cotton is close to zero. It appears that they may have forgone monopsonistic profit in an effort to set a price where cotton will be produced. Figure 5.5 illustrates how prices paid to domestic farmers for seed cotton stayed relatively constant while world lint prices dropped (here represented by the US cotton lint price). Clark is now focussing on obtaining adequate seed cotton for their gins outside of South Africa, while sitting out the production drought domestically. The sharp drop in the cotton world price in 2001/2002 was offset by a drastic weakening in the value of the South African Rand compared to the US$.

In 1992/93 the price differential between seed cotton and cotton lint was 348.5 cents but since then the price differential has widened substantially. Using 1992/93 as the reference year i.e., 1 for 1992/93, the price differential has increased to 1.6 in 2000/01 (Calcaterra & Poonyth, 2001). This indicates that ginners are reaping the benefits of the deregulated South African cotton environment and are not transmitting world prices of lint through to the farmers. This suggests a monopsonistic power.

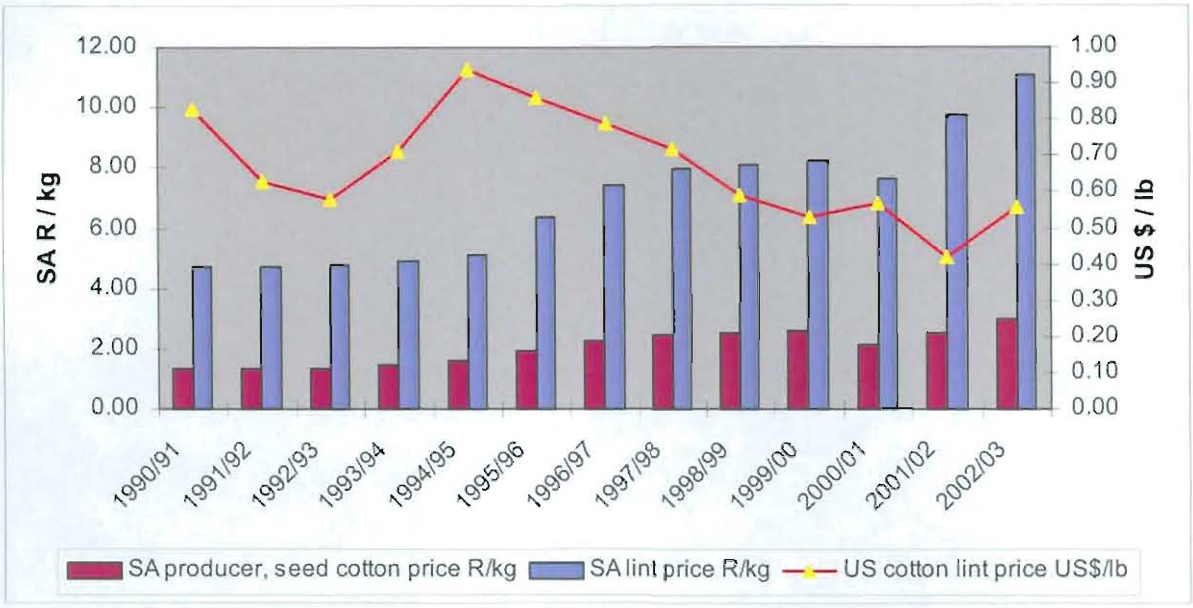

Figure 5.5: Seed cotton and cotton lint price trends

Source: Cotton SA

5.5.2 THE COTTON GIN AND THE SMALL-SCALE FARMER

The small-scale cotton producer situation on the Makhathini Flats in northern KwaZulu Natal has also taken a turn for the worse. To explain the problems and issues effecting cotton production on the Flats, one needs to understand the more recent cotton production history of the Flats. During the late 1980's Clark Cotton as well as Tongaat Cotton were active on the Flats, supplying credit and inputs and buying cotton from small-scale farmers. The two companies shared a weighing bridge and there was a positive attitude of cooperation between them. Even though some farmers borrowed production credit from one company and delivered their harvest under a different name to the other company, losses and gains balanced out for each company. Around 1989 Clark and Tongaat formed a partnership called Vunisa (which means "to harvest" in Zulu). In 1994/95 Lohnro Africa bought the cotton interests of the Tongaat-Hulett group and Tongaat's interest on the Flats was purchased by Clark. From then on Clark Cotton operated under the name of Vunisa in KwaZulu Natal and Swaziland. The Land Bank supplied credit and repayment default risk was shared between the Land Bank and Vunisa. Vunisa has administrated production loans since the 1998/99 season and according to Clark Cotton and Vunisa the first few years were very successful for both cotton farmers and the ginning company and there was a loan recovery rate of close to 90%.

During the 2001/02 production season a new company, Makhathini Cotton (Pty) Ltd (MCG) erected a new gin on the Flats, right next to the Vunisa depot. According to their website, their vision is "to stimulate rural development and reduce poverty on the Makhathini Flats by creating a world-class cotton agribusiness through construction of a ginnery in the heart of the area". But by opening a competing gin they have set in motion a chain of events where farmers borrowed production credit from Vunisa but delivered their harvest to the MCG. Due to substantial financial losses by Vunisa and the Land Bank, no credit was made available for the 2002/03 production season with the effect that very few farmers were able to produce cotton at all last season. Even with a new agricultural technology like genetically modified cotton, farmers still need production credit. At planting time 2003 a delegation of the Ubongwa farmer's association, that represents all the farmer's associations on the Flats, was still searching for a credit supplier. Vunisa was not planning to finance cotton on the Flats for the 2003/2004 season and they appeared to be focussing on their large-scale irrigation farmers in the Pongola area.

The Land Bank could probably provide credit but is understandably wary about investing in an area and in a crop that has already led to loan defaults of millions of Rands for themselves and other financial institutions. The South African Development Trust Corporation (STK), the Department for Development and Aid (DDA), the KwaZulu Finance and Investment Corporation (KFC) and the Development Bank of South Africa (DBSA) have all had roles in credit provision on the Flats over the years. The Land Bank and Vunisa do not seem interested anymore and it appears that MCG has decided that it would be more profitable to rent land for cotton production from farmers than to finance farmers to produce cotton themselves. This approach however also seems to have flaws as some farmers steal the cotton (produced on their own rented land) to deliver it to Vunisa and even to MCG. MCG is showing great initiative and determination in trying to establish irrigation cotton and wheat production units with the aim of establishing small-scale farmers on these areas over the longer term. From the history of the Makhathini Flats however we know that without some kind of cooperation between competitors (sometimes referred to as coopetition), development, poverty alleviation and economic progress on the Flats are not very likely.

5.6 WELFARE DISTRIBUTION

If the sum of the value of the yield and the value of the saving in insecticide costs (Chapter 4) are taken as the "additional benefit", increase in welfare / income or "economic rent" created by the introduction of new Bt technology in cotton, then the distribution of the additional income can be summarised as follows. (This distribution is based on the average production budgets of the different farmer groups.)

Table 5.2: Income distribution based on income advantage indicated by surveyed farmers

	Small-scale Dry-land farmers	Large-scale Dry-land farmers	Large-scale Irrigation farmers
Seed company: D&PL	3%	2%	1%
Technology supplier: Monsanto	28%	52%	20%
Farmer	69%	45%	79%
Consumer: Ginning companies	0%	0%	0%

Even though large-scale dry-land farmers are able to produce cotton more efficiently than small-scale farmers due to better management, mechanisation and use of fertiliser, small-scale farmers capture a larger share of the welfare because they pay a lower technology fee. Since world cotton prices are unaffected by SA production, yield increases in South Africa do not transmit down to consumers as they would if increased output led to lower prices. The welfare share accruing to the ginning companies is thus close to zero. Based on the pesticide savings indicated by surveyed farmers, we estimate that insecticide suppliers lost approximately 1.9 million SA Rand over the 2000/2001 season alone because fewer pesticides are used with Bt cotton.

Income distribution can also be calculated from the total monetary value created on the total area planted under Bt cotton. We make use of the 2000/01 figures for this calculation and seeding rates of 11.5, 8 and 20 kg/ha are assumed for small-scale, large-scale dry-land and irrigation farmers respectively. When percentage shares are calculated using the figures in Table 5.3, they are found to be similar to those

indicated in Table 5.2 that was calculated using the average budget figures of the different farmer groups as was indicated in Table 4.7. The small difference in the figures can be explained by different seeding rates and different planting practises. Table 5.3 also indicates the monetary value of the total decrease in chemical pesticides used / purchased by different farmer groups due to the introduction of insect resistant cotton.

Table 5.3: Monetary value of the total additional benefit according to farmer groups for the 2000/2001 season (in SA Rand)

	Small-scale Dry-land farmers	Large-scale Dry-land farmers	Large-scale Irrigation farmers	Total
Seed company: D&PL	32 546	54 576	74 156	161 278
Technology supplier: Monsanto	299 425	1 309 824	1 779 744	3 870 676
Farmer	1 038 647	1 323 468	5 988 097	8 350 212
Pesticide companies	-90 563	-777 708	-1 086 385	-1 954 656

If small-scale farmers have as high a seeding rate as some suspect, their welfare share might be lower than that indicated in Table 5.3 which is based on the seeding rate used by Ismaël et al (2001). Table 5.4 shows the sensitivity of the income distribution calculations to different assumptions concerning seeding rates. Table 5.4 also considers what small-scale farmers' welfare share would be if they had to pay the same technology fee as large-scale farmers.

Table 5.4 shows that small farmers are adversely affected if they use a lot of seed and if they have to pay the commercial level of the technology fee.

Table 5.4: Distribution of benefits for small-scale farmers under different seeding rate scenarios and technology fees

	Small-scale Dry-land farmers With a 11.5 kg/ha seeding rate	Small-scale Dry-land farmers With 20 kg/ha seeding rate	Small-scale Dry-land farmers Paying R600/bag techno fee*
Seed company: D&PL	2%	4%	2%
Technology supplier: Monsanto	20%	35%	52%
Farmer	78%	62%	46%

*Planting 11.5 kg/ha seed

5.7 CONCLUSION

It is clear from the income distribution results in Tables 5.2 through 5.4 that both large-scale and small-scale farmers are reaping benefits from the adoption of Bt cotton. Farmers are realising benefits despite the fact that they are facing two monopolists on the input side and a dormant monopsonist on the output side. Between increased diffusion of the Bt technology and new innovations now in the pipeline with herbicide-tolerant varieties and stack gene varieties entering or nearing SA input markets, farmers will probably be able to considerably increase productivity if the new varieties are approved for commercialisation. The reasons why it seems that the cotton industry in South Africa has turned for the worse can thus not be attributed to the presence of monopolists like Monsanto and D&PL. The SA ginning companies are dependent on domestic cotton producers for a large, consistent cotton harvest to justify their investments in fixed property, plant and equipment. Even though Clark Cotton might possibly have captured monopsonistic profits in the past, the company's profit margin has decreased over the last couple of seasons due to the low world cotton price and domestic farmers' reluctance or inability to produce at such a low price.

The technology developed in the developed world thus had a substantially positive impact on the cotton industry in South Africa and it is clear that both the commercial and smallholder sectors in a developing country can benefit from a first-world commercial agricultural technology. The most important factor may not be the technology treadmill or intellectual property rights or market structure harming

developing countries' agriculture, but agricultural subsidy policies of developed countries that stimulate production and force down world prices, which adversely effect domestic producers. Large-scale farmers in many instances can and do substitute maize or sunflowers for cotton when prices are low; but small-scale, resource poor farmers in most cases can not substitute away from cotton because of lack of credit or poor production conditions. In SA it may be small-scale cotton farmers that are hit the hardest by artificially low world cotton prices. Ironically it may be Western technology that is helping cotton farmers in this developing country survive the price squeeze created by developed country agricultural policies.