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Case study: Apparel industry waste management: a focus on recycling in South Africa

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The need for effective apparel waste management is motivated by the increasing cost and decreasing availability of landfill space and the dwindling of natural resources. The aim of this study was to identify the current solid waste disposal and recycling practices of the apparel industry in South Africa and to determine their attitude and willingness towards recycling, their perception of the feasibility thereof, barriers to recycling and marketing strategies that would be appropriate for products made from recycled materials. A structured questionnaire was mailed to apparel manufacturers in South Africa. The results indicated that most apparel manufacturers use landfills to dispose of their waste, while approximately half recycle some of the waste. They are fairly positive towards recycling, with consideration of economical feasibility. Phi-coefficients show no practically significant relationship between company size and the use of recycled materials. The most important barriers to recycling are lack of equipment and technology, lack of material to recycle and lack of consumer awareness. Marketing strategies for recycled products are recommended. It is concluded that consumer awareness and knowledge regarding recycled apparel products should be developed in order to ensure a market and that apparel manufacturers should be encouraged to recycle more extensively, in order to ensure that resources will not be exhausted unnecessarily and the environment will be preserved optimally.

Keywords: apparel industry, solid waste disposal, cutting waste, recycling

Introduction

Ecological consciousness and increased environmental awareness are growing steadily world-wide among manufacturers, retailers and consumers, who are all being encouraged to recycle waste and buy products made from recycled materials (Domina & Koch 1998, Negulescu *et al*. 1998, Dowdle 2005). The threat of unbridled consumption to the environment is confirmed by Gabriel & Lang (2006) who emphasize that all aspects of consumption impact on the environment. According to Domina & Koch (1998), apparel is one of the largely unexploited consumer commodities with strong recycling potential.

South Africa entered a new political era in the previous decade, which inevitably entails accelerated economic growth and development. This could bring about a renewed onslaught on the environment, as increased demands will be made on resources and more waste will be generated, increasing the need for solid waste disposal sites, which poses a severe problem considering the dwindling number of landfills and exploding landfill costs. This situation creates an opportunity for recycling of waste. Why then is this opportunity not fully exploited in South Africa? The answer often is that recycling is not economical (Mirrilees & Forster 1993). One of the extensive goals documented in the White Paper (Department of Environmental Affairs and Tourism 1997) on Environmental Management Policy was to set targets to minimize waste generation and pollution at source and promote a hierarchy of waste management practices, namely reduction of waste at source, re-use, recycling and safe disposal as a last resort. The most popular global approach to waste management seems to culminate in the 3Rs: reduce, re-use and recycle (Fletcher 2008), although El Haggar (2007) refers to 7Rs, adding the concepts of regulations, recovering, rethinking and renovation.

In the textile and apparel world, solid waste is produced at all points in the manufacturing process. The discarded materials are predominantly paper/cardboard, metals, glass, plastic, and textile products such as fibers, yarn, and cutting waste (Newenhouse 2000, Montgomery 2003).

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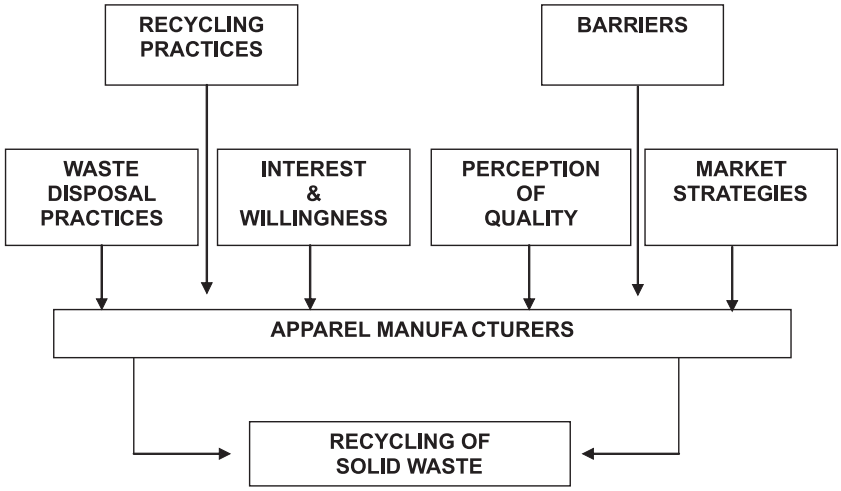

Fig. 1: Research framework.

In South Africa, environmental concerns in textile and apparel industries have also become more important during the last two decades. An example of efforts to manage waste better is Sasol's polypropylene plant at Secunda, which follows a 'cradle to grave' approach through which the entire process of manufacturing, use and disposal of textile products is planned to be environmentally compatible (Snyman 2008). However, if this approach is maintained, it may end in complete depletion of natural resources and also pose a problem of contamination in the air, water and soil. Newer production and processing techniques that represent the alternative cradle-to-cradle scenario promise possibilities of recovery in order to conserve natural resources (El-Haggar 2007). Alas, very little literature and information are available on recycling in the apparel industry. The multiple purpose of this investigation, therefore, was to investigate the South African apparel industry with regard to: (i) disposal practices for solid waste; (ii) recycling practices; (iii) interest and willingness to recycle; (iv) perception of quality of recycled products; (v) problems and barriers to enter the market for recycled products; and (vi) marketing strategies required for recycled products.

Research framework

A research framework (Figure 1), based on frameworks used by Grasso (1995) and Domina & Koch (1997) to investigate textile and apparel recycling practices, was designed to investigate various aspects of recycling in South Africa. The framework correlates with the objectives for this study and with the questionnaire. This research framework will subsequently be discussed.

Solid waste disposal practices

Neglecting recycling gives rise to the economic problems of loss of resources and energy, which may in turn impact on the profitability in the apparel industry. Gulich (2006b) confirmed that raw materials as well as waste disposal are becoming more and more expensive. Global resource consumption is growing, coupled with waste generation growing at a much higher rate, increasing the need for recycling (El-Haggar 2007, Fletcher 2008). According to Divita & Dillard (1999), cutting-room waste is a primary environmental concern and accounts for a large percentage of waste in the apparel industry. Negulescu *et al*. (1998) further point out that most of this cutting waste is dumped in landfills in the US. Woolridge *et al*. (2006) report that the main disposal routes in the UK are landfill and incineration, which could be considered a large resource loss with regard to the material.

Some manufacturers sell fabric waste in various forms. The importance of the sorting of waste and the fact that the waste should be in a good condition and free of foreign objects in order to ensure that waste is not viewed as garbage but rather as a valuable commodity is emphasised by Grasso (1995). This author also reports that those firms that sell their fabric waste are more likely to package it in boxes or bales than to bag or bundle it.

Recycling practices

Recycling can be defined as the process of treating things that have already been used so that they can be used again (Hornby 2005). Various ways to achieve this in the textile and apparel industries are discussed in the literature (Negulescu et al. 1998, Wang 2006, El-Haggar 2007). The Japan Chemical Fibers Association reported that improved technology has led to a significant rise in textile recycling programmes in Japan (Furukawa 2008). EcoGear manufactures environmentally friendly apparel by using cutting waste, shredding it into small fibres and combining it with continuous polyester thread made from recycled bottles (McDavid 2008). Montgomery (2003) reported that recycled rubber from motorcycle and bicycle tubes is, amongst others, used in textile fabrics and is a hot fashion trend in apparel. The company Patagonia in the US now recycles any garments made from Polartec polyester fabric (McDavid 2007). In Turkey, recycled polypropylene is reinforced with silk and cotton waste, resulting in a composite with improved mechanical and physical properties (Taşdemir

et al. 2007). Upholstery and automotive needlepunch fabric manufacturers experience an increased demand for polyester recycled fibres, for which conventional recycling processes of making reclaimed fibres can well be used (Gulich 2006a). Denim cutting-room scraps pose an environmental and economic problem. Burlington Industries and North Carolina State University have at last come up with a solution and have developed a technique to make jeans, in part, from reclaimed denim. The denim is made from 50% reclaimed denim yarn and 50% virgin cotton yarn (Folk 1994). Another innovative use of denim scraps is the manufacturing of unbleached 100% cotton rag paper, called Blue Jean Bond, which is undertaken by Esleeck in the US. The company reports that this pale blue paper can withstand repeated folding and handling, so that it is very suitable for legal documents and business and social correspondence (Crighton 1993).

Products made from recycled fabric waste include nonwovens used for insulation, padding, upholstery, oil filters, hospital drapes and gowns, as well as a variety of absorbent products like disposable wipes, geotextiles, carpets, fibrefill and spun-bonded fabrics from polyethylene. Many other products such as trims from unravelled knits are also manufactured (Larney *et al*. 1996, Gulich 2006a). Flocked fibres from finely-cut fabric waste which are applied to adhesive-coated surfaces and used for various purposes such as packaging materials for jewellery, is another practice (Langley & Kim 2006).

Interest and willingness to recycle

Globally, many of the bigger textile and apparel manufacturers are starting to take an environmental awareness position in the market. Incentives for recycling include savings on resources and their costs, reduction of waste, savings with respect to landfilling (dumping fees and space), and the creation of jobs (Larney *et al*. 1996). In the UK, a positive step by many companies is to establish an environmental management system to manage the environmental impact of industrial processes to be compatible with the best international standards. The apparel industry has been identified as the fastest growing waste recycling concern across the country and processes to encourage public participation and improved education have been some of the industry's key issues (Wheeler 2008). Dockery & Kalogeridis (1993) point out that interest and willingness to recycle textile and apparel waste is a stronger driving force than regulations or cost-saving initiatives. They report five environmental success stories that are all based on positive attitudes of manufacturers. One of these ingenious practices entails cotton waste being used for erosion control and as food for worms. Unfortunately, no matter how responsible the industries' actions may have become, the pragmatic question remains: 'How much can we afford to do for the environment while maintaining our competitiveness?' (Abend 1994).

Perception of quality of products containing recycled raw materials

Some authors point out that various manufacturers are of the opinion that products containing recycled raw materials are of an inferior quality and are afraid that some social stigma may be attached to recycled products (Grasso 1995, Heeley 1995). It is clear that there is no unanimous attitude regarding quality of products containing recycled raw materials, but currently many attempts are made to improve the quality such as using longer virgin fibres in blends with recycled fibres and combining recycled materials with strong polymers (Fletcher 2008).

Barriers encountered by manufacturers

There is much evidence in the literature that textile and apparel manufacturers encounter various barriers to entering a recycling programme, such as a shortage of markets for recycled products, a lack of equipment and technology, high costs and competition with countries that do not participate in environmental practices. Recycling is a dynamic process and, as markets become saturated with specific products such as wiping cloths and mop heads, new products have to be developed and introduced. Furthermore, special equipment is, for instance, necessary to shred fabrics, to separate waste and to extract fibres. A third and very important aspect is the cost of products as a barrier to entering the marketplace. Many of the processes are very labour-intensive, for example the sorting of waste (Gulich 2006b, Hawley 2006, Realff *et al*. 2000).

Marketing strategies

Carbone (1992) warns that companies wanting to stay in business have to be good environmentalists and have to follow effective strategies for recycling. Developing new markets as well as promoting public awareness seem to be important issues in the marketing strategies (Hawley 2006). Larney (1998) points out that recycled products are in most cases not of inferior quality and, therefore, need not be cheaper than products made from new materials. Larney *et al*. (1996) are of the opinion that consumers should also be made aware of the importance of supporting recycling practices and should be encouraged to acquire a positive attitude towards buying these products.

Materials and methods

After a thorough literature study and discussion with representatives of the industry, a questionnaire was developed that addressed the purpose and objectives of the study. The questionnaire and mail survey relied mainly on the method described by Dillman (1978) and correlated with the research framework. There were four questions on waste disposal practices used in the manufacturer's factory, nine questions on recycling practices, five questions on the manufacturer's interest and willingness to recycle (a five-point Likert scale), two questions on their perception of the quality of fabrics made from recycled fibres, five questions on barriers which the manufacturers might encounter in their efforts to recycle and nine questions on strategies deemed appropriate for marketing recycled products. Most of the questions required the selection of one specific option. The options are given in the tables. Several questions were open-ended, adding the

option 'other' to the list of options. The last question asked the respondent to make comments regarding recycling of apparel waste, allowing the respondent to give his or her own opinion on certain issues. Comments of similar nature were grouped together and discussed in the results section. Some questions allowed the respondent to select more than one option; therefore, the responses to some questions do not total 100%.

An address list of apparel manufacturers was supplied by the Clothing Federation of South Africa. A questionnaire, accompanied by an introductory letter and a self-addressed envelope, was mailed to 338 apparel manufacturers. Only 66 (20.43%) of the companies completed and returned the questionnaire.

Raw data were checked and mistakes were corrected before data analysis commenced. Statistical analyses were performed by the Department of Statistical Services of the North-West University with the use of the SAS statistical package (SAS Institute Inc. 1990). Frequency tables were used to present most of the data. Both raw numbers (n) and percentages (%) were given. For the Likert-scale questions, average values were calculated for each item in the scale to enable the researchers to do an importance ranking for each statement or question.

In the questions where the respondents had the opportunity to encircle all the responses that applied to them, each response was coded 1 if circled and 2 if left blank. This procedure permitted each response to be analyzed as a separate question and each of these responses could be compared with the size of company. Phi-coefficients were computed to determine effect sizes (Steyn 2000), in order to establish the practical significance of relationships between company size and each of the variables investigated in the questionnaire. Only one effect size, namely the relationship between company size and fabric waste disposal costs, was found practically significant and is discussed under results. All other effect sizes were not significant and are not discussed further. Steyn (2000) postulates that by using an effect size d (which does not depend on the sample size) as a measure of significance, a conclusion can be made about the importance of the difference between the means. To interpret the d-values, the following guideline can be used: $d = 0.2$, small difference or effect; $d = 0.5$, medium difference or effect; $d = 0.8$, big difference or effect.

Reliability

Due to the limited information on recycling in the apparel industry, this was an exploratory study, and reliability could not be determined by means of the most commonly used methods like the test/retest method (Huysamen 1996). The questionnaire was tested for clarity by three representatives of the apparel industry. According to Mouton & Marais (1989), reliability is determined by four variables, namely data collection technique, the influence of the researcher, the respondent and the research circumstances. Babbie & Mouton (2001) also mention clarity and specificity as measures to avoid unreliability. The researchers took all possible measures to comply with these given guidelines to ensure the collection of reliable data.

Validity

In this study, validity can be evaluated in terms of content validity, which reflects the extent to which the questionnaire measures what it is supposed to measure, and to which extent a measure covers the range of meanings included within the concept (Babbie & Mouton 2001, Murphy & Davidshover 2001). In this study, Murphy & Davidshover's procedure (2001) for assessing content validity was followed which consists of three steps, namely a literature study was undertaken to describe the content domain, and the researchers verified each test item to ensure that it represented an area of the content domain and that all the content domain areas were represented in the questionnaire. Lastly, the structure of the questionnaire was compared with the structure of the content domain, which in this study is represented by the research framework as depicted in Figure 1.

Results and discussion

Size of companies

Size of company was defined as the total number of employees at the plant. Small-sized companies were those that employed 100 or fewer people; medium-sized companies employed more than 100 but fewer than 500 people; and large companies employed more than 500 people. Most of the responding manufacturers (56.2%) could be categorized as medium sized, while 25.8% were small companies and only 18% were large companies. The responding companies represented four provinces in South Africa and most were situated in the Western Cape ($n = 36$) and Kwazulu-Natal ($n = 24$).

Waste disposal practices

Although various types of waste, such as fabric-cutting waste, thread waste, notion scraps, waste paper, yarn cones and tubes and packaging waste are produced by apparel manufacturers, most of the waste is fabric-cutting waste.

From Table 1, it is clear that various waste disposal practices were applied by these companies, and waste was mostly disposed of externally. Most apparel manufacturers (62.1%) made use of landfill, 42.4% practiced recycling, while 7.6% sold their fabric waste. Very few companies made use of the

Table 1: Fabric waste disposal practices of companies ($n = 66$).

Method	Internally		Externally	
	n	%	n	%
Landfilling	1	1.5	40	60.6
Incineration			1	1.5
Recycling	5	7.6	23	34.8
Stockpiling			1	1.5
Selling for external recycling			5	7.6
Giving away			1	1.5

other methods mentioned in Table 1. The fact that the fabric waste of more than half of these companies landed in landfill sites, shows that they had not yet seriously thought about other possibilities, or that they are not equipped to handle the waste in other ways. It is clear that there is an urgent need for attention to recycling fabric waste in the apparel industry globally, especially when considering the large amounts of fabric-cutting waste generated in clothing manufacturing industries (Tuggle 1995). As much as 15–20% of fabric is wasted in the cutting process (Frost 2008).

Companies were asked whether the location of their factories influenced their ability to dispose of solid waste. Responses indicated that, in 53.0% of the cases, location had no effect on this ability, while nearly a quarter were of the opinion that lenient zoning promotes disposal and 22.7% stated that their transport costs are higher due to location. From the low percentages of companies which indicated location to be a problem, it can be concluded that location is not a serious problem in the disposal of solid waste. Location will consequently not be a motivation for recycling, and other means of motivating companies to recycle will have to be found.

Regarding fabric-cutting waste disposal costs, the majority (71.2%) indicated that cutting waste disposal costs made up less than 5% of their operating budget. The fact that it is not overly expensive to dispose of cutting waste emphasises that this factor is also not a very important motivation for recycling. However, a quarter of the respondents were not aware of what the disposal costs were. Effect sizes were statistically determined, and indicated a medium practically significant relationship ($d = 0.5$) between manufacturers who have an accurate knowledge of what their cutting waste disposal costs are, and the waste disposal costs as a percentage of their operating budget. Those who had accurate knowledge about their cutting waste costs spent less on disposal of cutting waste.

Recycling practices

Apart from the expected fabric-cutting waste, apparel manufacturers in addition generated solid waste from items such as yarn cones and packaging materials. The most frequently recycled non-fabric products were paper-based items which are easy to recycle and for which there is a big demand. This corresponds with the findings of a study by Dockery & Kalogeridis (1993). Fletcher (2008) confirms that a demand is a condition for the supply of recycled products.

Items which were most often recycled (Table 2), included cardboard (65.2% of the companies), fabric-cutting waste (56.1%), yarn cones and yarn tubes (53.9%) and waste paper (48.5% of the companies).

Those companies that recycled their fabric-cutting waste used more than one recycling practice. Of those responding to this particular question ($n = 64$), the following information was obtained: 23.4% sold their cutting waste to another manufacturer that uses the waste in its production, 7.8% processed their waste further within their own company, 20.3% sold their waste to another company that specialises in recycling while 7.8% donated their waste to charity. The fact that the fabric-cutting waste of nearly half the responding companies was not recycled at all points to a need for a paradigm shift regarding the recycling of fabric-cutting waste.

Table 2: Items most often recycled ($n = 66$).

Item	Companies (%)
Boxes, cardboard	65.2
Fabric-cutting waste	56.1
Yarn cones/tubes	53.9
Waste paper	48.5
Packaging materials	33.3
Thread waste	16.7
Yarn waste	10.6
Fibre waste	9.1
Aluminium cans	3.0
Waste effluent, water, heat, *etc.*	3.0
Notion scraps	3.0
Pallets	1.5

The companies that sold their fabric-cutting waste ($n = 28$) could sell it either as sorted or unsorted combined waste in different packaging forms. The results show that bags was the most popular packaging form for 50.0% of companies and that 25.0% of those companies that sold their waste sorted it before selling. The latter obviously value their waste and see it as a useful commodity for other manufacturers (recyclers) to whom it is important to buy debris-free waste in sorted form (Dockery & Kalogeridis 1993, Domina & Koch 1997).

Interest and willingness to recycle

Regarding the current situation, 37.9% of the respondents indicated that they do recycle on a regular basis, while 15.4% planned to do so in future. The majority (42.1%) had no plans to recycle their waste, not even in future. Eighty-five percent agreed that recycling has beneficial values, while 78.0% pointed out that they were willing to manufacture products from recycled materials. Many (75.6%) were willing to wear apparel made from recycled fibers. Larney (1998) points out that it is encouraging that some manufacturers plan to recycle in future, as it might become a necessity. Apparel manufacturers' willingness to use recycled products in their production was investigated.

Nearly two-thirds (65.5%) were willing to use recycled materials if available. The amount of recycled material actually used by the respondents, varied considerably (Table 3). No recycled fibre was used by 77.4% of manufacturers, no recycled yarn by 75.9%, no recycled fabric by 61.4% and no other recycled materials by 78.7% of manufacturers. Another facet of manufacturers' interest in recycling was reflected by their willingness to pay certain prices for recycled raw materials. The majority of the respondents indicated that if they were going to use recycled materials in their production, the

Table 3: Percentage recycled material used in production ($n = 66$).

Amount	Fibre %	Yarn %	Fabric %	Other %
None	77.4	75.9	61.4	78.7
< 2%	18.9	18.6	28.1	14.9
2–4%	1.9	1.9	3.5	4.3
5–7%	0	1.9	1.8	0
8–10%	1.9	1.9	3.5	2.1
11–25%			1.8	

price should be economically feasible. Seventy-eight percent pointed out that the price should be significantly lower, while 14.3% said that it should be slightly lower than that of new raw materials. Twelve percent of the manufacturers believed that it would be more expensive to use recycled materials in their production, while 59.4% were not sure.

Perception of quality

Half of the respondents believed that the quality of sewn products made from recycled textile materials would be considerably lower than the quality of products made from new materials, while 34.1% believed it would be slightly lower. The reason for this view could be conventional, stemming from a premise that waste is valueless. Heeley (1995) reports that there is still some social stigma attached to 'second-hand' or 'recycled'. Gulich (2006b) points out that it is hard to define the quality of reclaimed fibres, as the end-product depends on many factors such as the degree of material breakdown, fibre length and the composition of blends. There is also evidence that serious research was being undertaken to improve the quality of recycled products. Folk (1994) reports that Burlington Industries as well as the University of North Carolina had for a long time experimented to develop a technique that would yield a strong enough yarn from denim waste. Just more than a third (34.4%) of the respondents were of the opinion that sewn products made from recycled materials may be a potential liability for their company, in that sales might drop if clients become aware of the fact that products were made from recycled materials.

Barriers to recycling

Respondents could rank the top three barriers that keep them from recycling products and entering the recycled product market.

In Table 4, the respondents were asked to give a priority rating of barriers to recycling (first choice, most significant barrier; third choice, least significant barrier). According to Table 4, about a quarter (25.8%) of the respondents indicated that lack of equipment was their major problem. Lack of technology was ranked first by 16.7%, while 13.6% pointed the lack of material for recycling out as a major problem. Lack of consumer awareness was chosen as the most significant barrier by 10.6% of the respondents. Cost of the product was considered the second most important barrier by 15.2% of the respondents. Phi-coefficients (d) were all below 0.2, and consequently revealed no practically significant relationships between size of the manufacturer and the rating of barriers. Research literature sometimes expresses the opinion that it is more costly to produce products from recycled than from new raw materials (Maycumber 1994), which may be an indication that manufacturers' perception is realistic that it is expensive to recycle.

Marketing strategies

Manufacturers' view of desired marketing strategies and commendable levels of promotion for recycled products is depicted in Table 5.

For a recycled product to enter the market, its price should be compatible with its quality. The main problem in this regard seems to be that prices of recycled raw materials are still high, due to high manufacturing costs (Morgan 1995). As most of the respondents believed that the quality of recycled products will be lower, a notable number (44.6%) were also of the opinion that these products should be priced lower than products made from new material. Thirty-two percent thought that it should be positioned at a low-to-medium price point, while only a few (5.4%) recommended a price point towards the high end. Regarding level of promotion, nearly a third (32.7%) recommended the same promotional costs, while 29.1% recommended a significantly higher, and only 9.1% a significantly lower promotional cost than for products made from new materials. Grasso (1995) warns that higher promotional costs will lower the profit margin.

To promote the entrance of recycled products into the market, 73.7% of the respondents were of the opinion that a marketing strategy that creates a strong consumer demand should be followed, while 67.2% believed in a market strategy that creates a strong trade or channel demand. Nearly one-third (31.2%) of the respondents were not sure that they would attract a new target market if they used recy-

Table 4: The most significant barriers ($n = 66$).

	n	1st choice	n	2nd choice	n	3rd choice
Lack of equipment	17	25.8%	8	12.1%	4	6.1%
Lack of technology	11	16.7%	6	9.1%	5	7.6%
Lack of material	9	13.6%	7	10.6%	7	10.6%
Lack of consumer awareness	7	10.6%	7	10.6%	5	7.6%
Production costs	3	4.5%	10	15.2%	6	9.1%

Table 5: Marketing strategies for products containing recycled material ($n = 66$).

Price point	%	Level of promotion	%
Low end	44.6	Significantly less	9.1
Low-to-moderate	32.1	Slightly less	7.3
Moderate	17.9	About the same	32.7
Moderate-to-high	3.6	Slightly more	21.8
High end	1.8	Significantly more	29.1

cled products in their production, while 53.1% thought it might be a potential market. Regarding the type of promotion considered necessary, 37.9% respondents recommended trade shows while 36.6% recommended point-of-purchase promotion. Direct sales and advertising in trade journals were recommended by an equal number (31.8%) of respondents.

Conclusions

The use of landfill sites seems to be the most important practice used by the apparel industry to dispose of solid waste. In the light of the dwindling number of landfill sites and the exploding landfill costs, it seems imperative that recycling should be pursued more urgently by all stakeholders, which include consumers, the South African Clothing Federation, the industry itself and government. Especially in South Africa, where housing is inadequate, it is irresponsible to use precious land for landfill. One factor that may play a role in inhibiting recycling practices is the low waste disposal costs (for cutting waste less than 5% of their operating budget, reported by most manufacturers). Although only about a third of the clothing manufacturers recycle some of their waste (mostly cardboard boxes, fabric cutting waste and yarn cones) on a regular basis, more than three-quarters have a positive attitude towards recycling and two-thirds are willing to use recycled materials in their production. The majority, however, agreed that they can only consider using recycled materials if it will be economically feasible. Half the respondents had the perception that the quality of products made from recycled materials was lower than that made from new materials. Research results indicate that, in most cases, the quality of recycled raw materials is not lower, and manufacturers as well as consumers should be made aware of these findings. Lack of equipment was mentioned as the most important barrier to recycling, which can be ascribed to the fact that modern equipment is very expensive, and sometimes was not available due to sanctions against South Africa during the apartheid era. Suitable technology also seems to be lacking. Considering the relatively difficult financial situation in which the textile and apparel industries are, world-wide as well as in South Africa, it can be assumed that they cannot afford sophisticated recycling equipment and it is recommended that the South African Government makes a serious effort to assist them in updating and replenishing their equipment and to subsidise research towards improved recycling technology. Regarding marketing strategies, it was clear that consumer demand should be seriously considered and that prices should be at the lower rather than the higher end for recycled products. New value-markets should also be developed continuously. Instances such as the South African Clothing Federation as well as the Department of Environmental Affairs should be encouraged to launch campaigns to promote the interest of recycled textile and apparel products specifically. Consumers must be made aware of the advantages and the stigma of inferiority and cheapness must be removed by educating consumers, as they are said to determine production, to stimulate innovation and to be able to control the environment and protect the future of the globe.

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