

Addressing post-consumer textile waste in developing economies

Pammi Sinha, D. G. K. Dissanayke, R. P. Abeysooriya & B. H. N. Bulathgama

To cite this article: Pammi Sinha, D. G. K. Dissanayke, R. P. Abeysooriya & B. H. N. Bulathgama (2022) Addressing post-consumer textile waste in developing economies, The Journal of The Textile Institute, 113:9, 1887-1907, DOI: [10.1080/00405000.2021.1954428](https://doi.org/10.1080/00405000.2021.1954428)

To link to this article: <https://doi.org/10.1080/00405000.2021.1954428>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 02 Aug 2021.



Submit your article to this journal [↗](#)



Article views: 1989



View related articles [↗](#)





View Crossmark data [↗](#)



Citing articles: 2 View citing articles [↗](#)

Addressing post-consumer textile waste in developing economies

Pammi Sinha^a , D. G. K. Dissanayake^b , R. P. Abeysooriya^b and B. H. N. Bulathgama^b

^aSchool of Design, University of Leeds, Leeds, UK; ^bDepartment of Textile & Clothing Technology, University of Moratuwa, Moratuwa, Sri Lanka

ABSTRACT

Consumer attitudes and disposal behaviour of textiles in developing economies are under researched, constraining capacity to address dual environmental challenges of increasingly disposable fashion and inefficient waste collection programs. We present the results of a systematic case study about post-consumer textiles waste in Colombo, Sri Lanka. Taking post-consumer textile waste as our unit of analysis, we conducted in-depth and semi-structured interviews with the local industry stakeholders, the waste management infrastructure and an island-wide survey of consumer attitudes and disposal behaviour towards post-consumer textile waste. The results indicate: (a) considerably more post-consumer textile waste than recorded at landfills; (b) consumption and disposal behaviour comparable with developed economies, significant in contexts of no formal mechanisms to address end of life post-consumer textile waste and (c) age, employment category, income level and geographical location, are statistically significant in understanding public textile waste disposal behaviour, indicating importance of appropriate policy and infrastructure issues.

ARTICLE HISTORY

Received 22 February 2021
Accepted 7 July 2021

KEYWORDS

Post-consumer textile waste; disposal behaviour; waste management; developing economies

1. Introduction

Textile wastes can be classified as post-industrial (arising out of industrial processes) or post-consumer textile wastes (PCTW). Post-industrial textiles wastes refer to the waste generated during textile and apparel manufacturing process such as cutting waste, quality rejections and excess fabrics (Dissanayake et al., 2021). PCTW consist of the textile products that are disposed of as the owner no longer wants it (Domina & Koch, 1999; Hawley, 2006; Nencková et al., 2020). Current efforts at addressing PCTW (mainly in developed economies) have been through collaborative efforts, e.g. place-based, grassroots collaborations led by social enterprises (e.g. Zero Waste Leeds) or consortia of international industry and research organisations such as European Clothing Action Plan to develop recycling technologies to sort and recycle textiles. Despite these efforts, upscaling from 1% recycled textiles in the fashion system (Ellen MacArthur Foundation, 2017) seems to remain elusive and the impact of the pandemic has seen used clothing markets destinations diminish or close (TRA, 2020).

A systematic approach is required to address PCTW: assessment of volume, an understanding of consumer behaviour, local municipal solid waste management practices and policies alongside technological efforts and supply chain innovations. Our research objectives were to develop an understanding of the first three in Sri Lanka, a developing economy. The most recent publicly available study estimates that the percentage of textiles in total landfill volumes in Sri

Lanka is worryingly similar to the USA – up to 5.9% in Sri Lanka (JICA, 2016) and 6% in USA, (Kaza et al., 2018; Shirvanimoghaddam et al., 2019). In Sri Lanka, textile recycling facilities are limited to post-industrial textile waste. With no source separation from household waste, PCTW, categorised as non-hazardous and inorganic, becomes part of mixed waste. Contaminated with other wastes it is rendered unusable and destined for landfill (open dumping) or incineration (Dissanayake et al., 2018), perpetuating lack of public engagement in a circular economy of textiles.

Consumer attitudes determine the disposal methods of PCTW (Laitala, 2014). A summary of our extensive literature review to explore consumer disposal behaviour of PCTW is presented in Table A1 (Appendix A). Using keywords ‘post-consumer textile waste’, ‘consumer behaviour’ and ‘disposal behaviour’, Scopus and Web of Science databases were searched during October 2020 for empirically based, peer reviewed articles, written in English from 1995 (when reports of fast fashion business models began to proliferate). Of the 29 journal papers reviewed, only 5 were in the developing economy context: (Lang & Zhang, 2019; McNeill et al., 2020a, 2020b; Nørup et al., 2019; Paço et al., 2020; Zhang et al., 2020). From our review, top five consumer issues were identified as:

- Awareness – communications, publicity, marketing or educational campaigns about environmental impacts of textile waste.

- Fashion value – how and what is valued of the textiles/ clothing and implications for post-consumer textile waste.
- Textile durability – how long textiles are kept before discard.
- Disposal route – how consumers discard textiles (most popular were donation or resale).
- Environmental attitudes – while a positive relationship was identified between awareness of environmental concerns and disposal behaviour (Bianchi & Birtwistle, 2010; Joung & Park-Poaps, 2013; Shim, 1995), Joung (2014) found that consumers' interests in the environment do not necessarily drive their sustainable disposal behaviour.

2. Methodology

This study, conducted in two phases in Colombo, aimed to develop a systematic case study about stakeholder activities around PCTW (Yin, 2013). During the first phase, in-depth and semi-structured interviews were conducted with the stakeholders, and in the second phase, an island-wide consumer survey was conducted. Qualitative and quantitative data collection took place as described below.

- i. Site visits and interviews to gain an overview of textile waste between 17–24 February 2020. The stakeholders interviewed included: multinational apparel manufacturers (companies A, B and C), fashion and textile designers, textile and garment reselling agents and small businesses, the Waste Management Authority (Western province), the Central Environment Authority, the Tax Office, the Board of Investment (BOI) Environmental Management Division, and a social enterprise specialising in waste collection in the Colombo area.
- ii. Karadiyana dumpsite: site visit and interview of the site manager to understand the waste collection process from the local council perspective.
- iii. Telephone interviews (due to covid curfews) with waste collecting agents to better understand market dynamics for the business of collecting recyclable materials, during May 2020.
- iv. An island-wide web-based questionnaire survey was conducted between April to June 2020 to identify public behaviour and attitudes towards disposal of post-consumer textiles; to the best of our knowledge, the first of its kind in Sri Lanka. A pilot survey administered to 25 participants helped us refine our questionnaire. The refined questionnaire was administered online to a geographically and demographically representative sample of citizens of Sri Lanka, over 18 years old in all nine provinces; Western, Central, Southern, Northern, Eastern, North-Western, North-Central, Uwa, and Sabaragamuwa, based on the latest figures available in the Department of Statistics (Central Bank of Sri Lanka, 2020). Six socio-demographic variables were used: age, employment, education, income level, family size and the land size of the residence. The survey was constructed around four key themes:
 - a. Consumer disposal routes of PCTW and factors that influence them
 - b. Consumer attitudes and perceptions regarding textile waste
 - c. Consumer awareness and appreciation of products made from PCTW
 - d. Consumer responsibility and positive contribution in disposing of textile waste effectively

431 responses were scrutinised and only questionnaires with complete data were included in the clustering analysis. Appropriate scales were developed to measure responses. The survey results were statistically analysed in SPSS v25 package. Different hypotheses were tested subject to the 95% confidence level. Auto clustering method identified possible clusters using the clustering criterion; Akaike's Information Criterion (AIC). A cluster analysis was conducted using SPSS v25, based on demographics and household reactions for PCTW, the two-step cluster analysis identified three clusters of divestment groups. The cluster quality and validity was determined by the silhouette measure as suggested by Norusis (2008); the silhouette measure described how far the clusters were from each other and how tight within. Each consumer disposal route response was measured initially in a Likert scale: 1: *strongly disagree* to 5: *strongly agree*. Next, the variables describing consumer behaviours towards PCTW were measured in scale of *always*, *sometimes*, and *never*, according to the levels of their actions. The variables evaluating the support for PCTW related products were measured in scale of 0–9 while the measuring variables for consumer contribution to the effective management of PCTW were measured in discontinuous scale. In analysis, chi-square statistics were used to identify any significant differences in frequency of stating 'yes' over 'no' for each variable in themes c) and d).

3. Results

3.1. An overview of textile waste arisings

Figure 1 illustrates where and how textile waste is created, and the well-defined route for post-industrial textile waste. The shaded boxes identify links between export processing zones (EPZ) and the domestic market, i.e. where the textiles enter the domestic markets. Within the domestic market, retail, design, and second-hand clothing market are consumption sources, contributing to PCTW. Multinational companies (A, B and C) are legally obliged to address any textiles waste from their operations. Contracted licensed waste collectors transfer recyclable textile waste to various recycling centres; where not possible, the route taken depends on their agreements with brand customers. Through 'brand protection unit' (BPU) buying group may allow excess stock, inventory or cancelled orders to be (i) de-branded and sold in local market, (ii) upcycled or (iii) cut into panels and sent to CSR projects. Branded stocks with no such permissions are slashed, all metals removed and sent to incinerators as waste to energy or entry into cement industry (as ash for cement or brickwork).

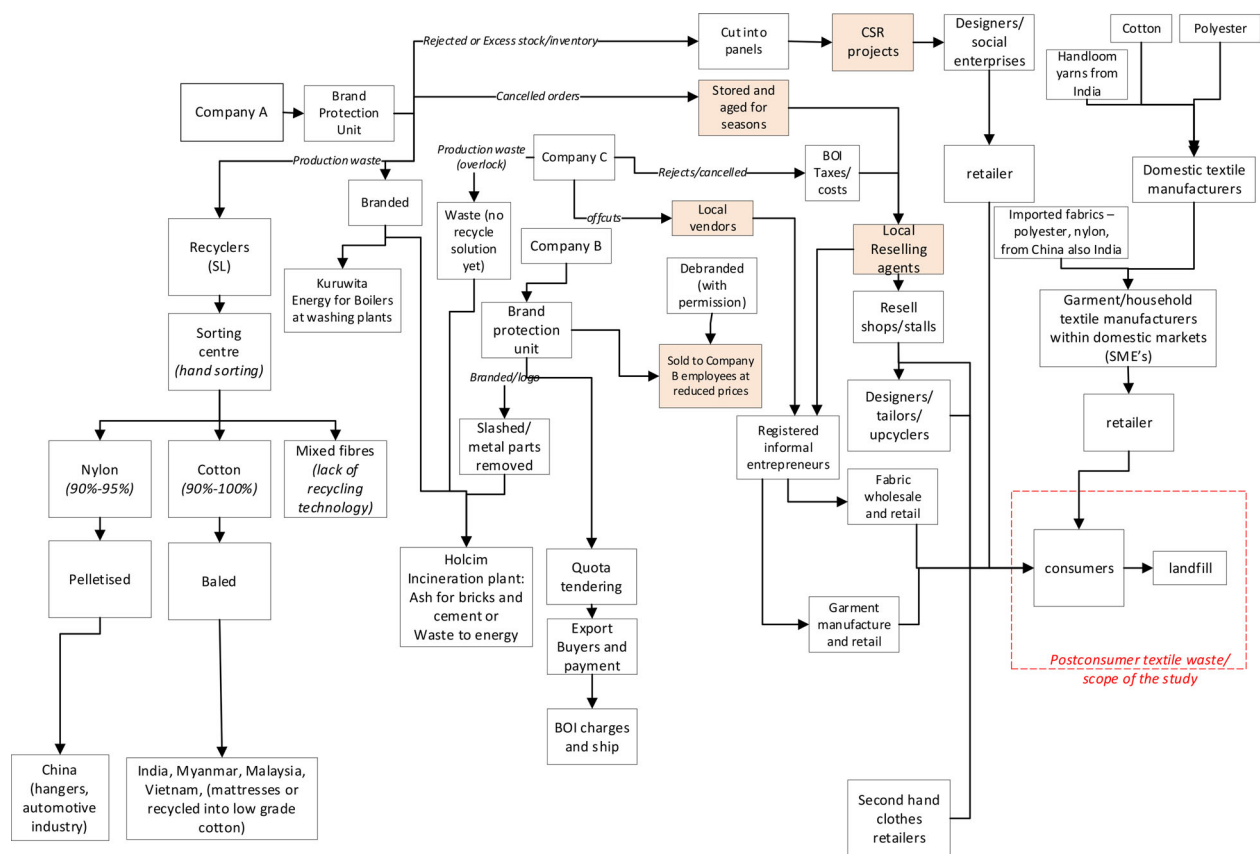


Figure 1. Textile waste arising in Colombo.

3.2. An overview of municipal waste management at the dumpsite

Figure 2 illustrates the flow of waste into and out of Karadiyana, which serves seven districts in and around Colombo. An open dumpsite, it operates through two sites – as one site fills, it is covered, and the other site is used. Waste is collected from households and businesses by council or privately licensed collectors and brought to the site to be paid for discharge. Organic waste goes to the compost plant, mixed waste to the dumpsite. Licensed waste pickers collect residual recyclable materials, for example cardboard, paper, plastic, metals, etc., as illustrated in Figure 2 and take them to the waste collectors who sell on to recycling businesses. There is no scheme to separate PCTW prior to entering mixed waste.

3.3. The business of collecting recyclable materials

29 recyclable materials were identified; cardboard, newspapers and iron were most commonly collected. The prices of buying recyclable materials from waste pickers and selling to recycling firms varied greatly between the lowest and highest prices. Averages, therefore, were used to calculate that potential margins for waste collectors were between 1.12–2x. The highest margins seem to be with glass bottles (4x), followed by batteries (2.3x) and then Cheenachatti (a brass skillet) (2x). Of the 27 interviewed, one of the waste collectors gathered post-industrial textiles if the quantity was large enough. Seven waste collectors expressed positive

opinions about collecting textiles but acknowledged problems such as lack of knowledge about the textile structure and technologies prevented them from considering this as a business.

3.4. Public behaviour and attitudes towards disposal of post-consumer textiles

The boxed area in Figure 1 (PCTW journey to the dumpsite after discard from consumers) formed the focus of our survey questionnaire.

3.4.1. Cluster analysis

Table 1 illustrates the three divestment clusters identified; disposal routes and behaviours towards PCTW are presented in Tables 2 and 3, respectively based on the clusters identified.

According to Table 2, students/unemployed and professionals employ more sustainable disposal routes than blue collar workers. The most popular response of the student/unemployed and the professional clusters is 'never throw-out wipers but look for alternative ways to reuse them', while the least preferred option is 'selling', which is dominated by blue collar workers. Table 2 denotes 'Yes' for the responses of 1–3 in the Likert scale and 'No' for the responses of 4–5.

Table 3 summarize the analyzed responses for each variable as 'Yes' when the total of 'always' and 'sometimes' responses are > 50% and 'No' when the total of 'never' and 'sometimes' responses are > 50%. According to Table 3,

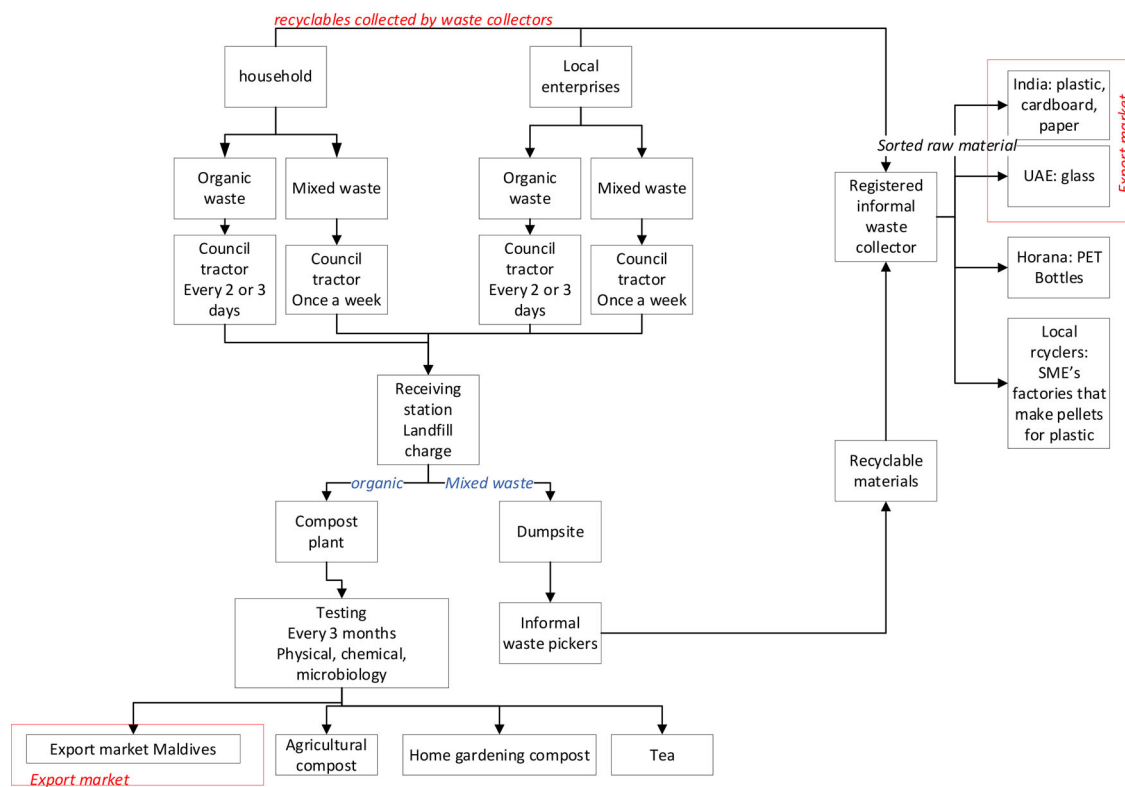


Figure 2. Activities around managing waste.

Table 1. Three divestment clusters.

	Blue collar worker	Student/Unemployed	Professional
Cluster Size	Cluster 1 21.6%	Cluster 2 33.4%	Cluster 3 45.0%
Age group	25–49 65.6% of this cluster	19–24 65.3% of this cluster	25–49 85.6% of this cluster
Income (LKR)	High 61% earn >75k	Low – middle 92% earn <75 K	High 97% earn >75k
Education	some what 31% below average (not graduates)	low 47% below average (not graduated)	educated 80% are above average education
Employment	equal tendency to be employed or unemployed	unemployed category or students	employed/fulltime professionals
Land size	mainly with small land size (less than 10 perches)	66% of this cluster No particular land size significantly highlighted	50% professional No particular land size significantly highlighted

Table 2. Disposal routes for PCTW.

Disposal routes	Blue collar worker	Student/unemployed	Professional
Selling PCTW	Yes (64.5% prefer to)	No (90% prefer not to)	No (90% prefer not to)
Hand down within families	No (93.5% prefer not to)	Yes (71.5% prefer to)	Yes (68.1% prefer to)
Donate give away to poor or servants	No (88% tend not to)	Yes (78.5% tend to)	Yes (78.6% tend to)
Reuse/Recycle	No (96% do not)	Yes (77%)	Yes (82%)
Throw out only when unusable	No (85% prefer to remove before unusable)	Agreed by 78.5%	Agreed by 78%
Never throw out wipers but look for ways to reuse them	Tend not to (63% would not look for ways to reuse wipers)	Prefer to (80% would look for ways to reuse wipers)	Prefer to (83% would look for ways to reuse wipers)

‘collecting and burning’ was the most common disposal behaviour, followed by ‘waiting for the municipal council to collect’. ‘Throw away onto open ground’ was not commonly practiced, regardless of cluster.

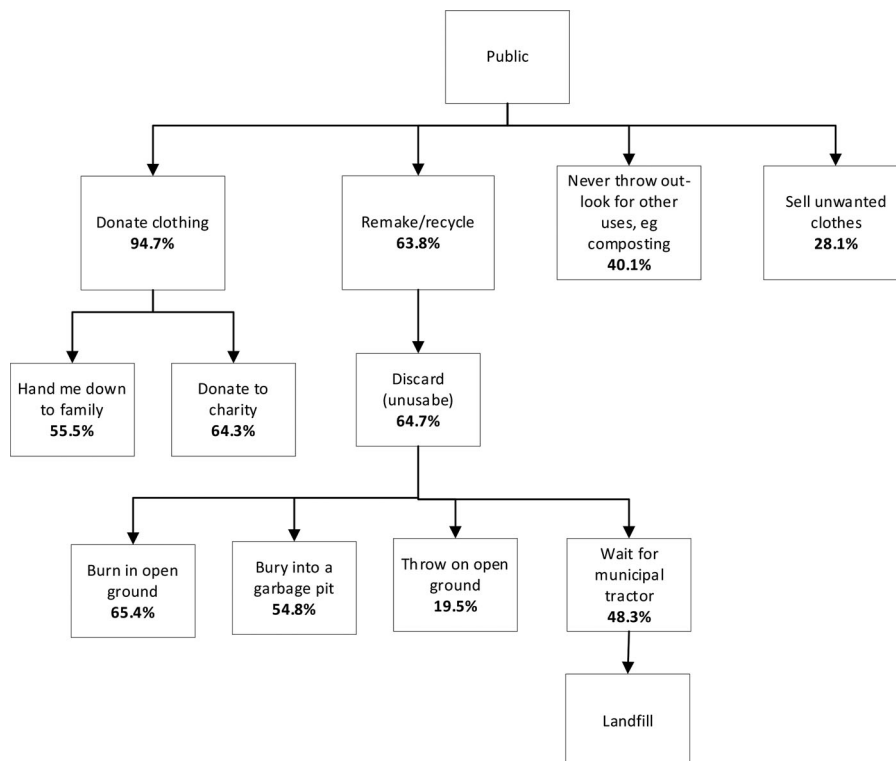
Table 4 summarises the respondents’ support for PCTW related products, which was measured in scale of 0–9. The ‘No’ responses denoted poor ratings from 0 to 2 while ‘Yes’ responses received greater than or equal to 3 up to 6, the

Table 3. Disposal behaviour towards PCTW.

Behaviour	Blue collar worker	Student/ unemployed	Professional
Burying waste into garbage pit	Yes 60% sometimes or always	Yes 59% sometimes or always	Yes 50% sometimes or always
Wait till Municipal Council to collect	Yes 59% Sometimes + always	Yes 52% Sometimes + always responses	Yes 72% Sometimes + always
Throw away open ground	No 80% never	No 83% never	No 79% never
Composting	No 52% rarely or never	Yes 51% sometimes or always	No 70% rarely or never
Collecting and burning	Yes 73% Sometimes or always	Yes 68% Sometimes or always	Yes 60% Sometimes + always

Table 4. Support for PCTW related products.

Support	Blue collar worker	Student/ unemployed	Professional
Prefer to buy PCTW products	No (63.5%)	Yes (56%)	High rating (56%)
Persuade family and friends to recycle PCTW	No (65.6%)	Yes (67.4%)	High rating (62.4%)
Proud to wear products made from PCTW	No (61.3%)	High rating (59.7%)	High rating (54%)
Willingness to change to environmentally friendly brand	High rating (53.6%)	High rating (84.7%)	High rating (82.5%)

**Figure 3.** Consumer behaviour and routes to end of life of PCTW based on questionnaire responses (% refer to the proportions of the population responses).

responses from 7 to 9 were highlighted as 'High rating'. According to Table 4, 'willingness to change to environmentally friendly brand' was highly rated across all clusters. 'Willingness to support products made out of PCTW' was not especially strong – in the 50–60% range.

Further findings from the cluster analysis across all the population revealed the following:

- Only 13% do not segregate textile before discarding and they prefer to donate than sell (see Figure 3).
- Strong belief in socially responsible clothing business (78% of households highly believes this)
- Consider repairing before removing PCTW (89%)
- Education on reusing/recycling PCTW is not high:
- Aware of how to repair/reuse PCTW (56.4%)
- Aware of places/organisations repair/reuse PCTW (45%)
- Value PCTW (91%)
- Aware how hazardous PCTW could be (77%)

3.4.2. Consumer responsibility and participation in waste management programs

Table 5 presents the chi-square test assessed consumer responsibility and active participation in waste management programs. Only around half of the number of respondents contribute to waste collection programs, significant

Table 5. Consumer contribution to the effective management of PCTW.

Measuring variable	Response	Exceptions
Contribution towards waste collection programs	Inconclusive Chi-Sq. 1.222 ^b , Sig <i>p</i> -value 0.269 > 0.05.	
Take follow up actions given by the waste controlling and management programs	Yes Chi-Sq. 22.635 ^b , Sig <i>p</i> -value 0.000	Geographical area (Sig <i>p</i> -value 0.000), Eastern and North-central consumers significantly do not take follow up actions
Awareness of the hazardousness of textile waste to the environment	Yes Chi-Sq. 129.721 ^b , Sig <i>p</i> -value 0.000	Geographical area (Sig <i>p</i> -value 0.000), Eastern province consumers less aware of how hazardous the textile waste
Receive any information or education related to textile waste management	No Chi-Sq. 8.039 ^b , Sig <i>p</i> -value 0.005	
Believe the value for textile waste	Yes Chi-Sq. 294.339 ^b , Sig <i>p</i> -value 0.000	

^aThe corresponding minimum expected counts received are matched with the assumptions of Chi-square test.

^bThe likelihood ratio results were considered based on the percentage of expected counts less than 5.

Table 6. extending life of clothing and textiles (% refer to the proportions of the population responses).

Repair activities	Items held into
Sewing on buttons (85%)	Buttons (56.1%)
Readjusting the size of clothing (68.6%)	Zippers (35.8%)
Patch holes/ripped seams (65.8%)	Lace (37.4%)
Replacing zippers (60.3%)	Embroidery (28.4%)
Taking up hems (49.2%)	
Replacing panel from clothing (38.6%)	

differences being geography – i.e. Eastern and North Central areas. Consumers in the Eastern area are less aware of the hazardous environmental impact of textiles. Households received no information or education specifically related to textile waste management.

3.4.3. Attempts to extend clothing life and consumer attachment to PCTW

Table 6 presents consumers' attempts in extending the life of clothing, assessed using a pre-defined set of activities, which revealed willingness to repair before disposal. Buttons were the most popular items to be held onto before discarding. There was nearly nothing recorded for belts and elastics, or parts of the fabrics.

3.4.4. Routes to end of life for PCTW

Figure 3, developed from the responses to the questions 9, 10 and 11, illustrates that, prior to end of life, 'donation' and 'remake or recycle' (e.g. redesigned, repaired or made into wipers) were most popular mechanisms to address PCTW. The four routes to end of life of PCTW were: burning, burying, throwing away onto open ground and collected as inorganic household rubbish to landfill. Landfill volumes do not represent the total PCTW causing negative environmental impacts. Behaviour is circumstantial, e.g. if a council lorry did not arrive, households would consider the alternatives and decide according to the situation. The questions were measured through a Likert scale from 'never' to 'always'. Only a 'never' response was interpreted as a negative response – all others were taken as a positive response (e.g. 'rarely' burn was in the 'yes' group as on some occasions, the household would burn textiles).

Question 9 'When you are ready to discard your unwanted textiles/clothing, do you ...': 431 responses were received and consumers were asked about prior to discard: 374 segregated (87%), 121 sold on unwanted garments (28%), and 408 donated (95%). As 87% responded that they 'segregate prior to discard', 13% did not segregate; the questionnaire did not identify fate of unsegregated garments through the questionnaire.

Question10 'When segregating unwanted clothing/textiles, how far you would agree on the following statements ...': The responses highlighted that about two thirds of the sample strongly agreed/agreed that they only threw textiles out when they were completely unusable.

Question 11 'If you "throw away" your unwanted textiles/clothing, do you use any of the following methods to dispose': 48.3% people confirmed that they strongly agreed/agreed that they waited for the municipal tractor to remove their unwanted textile/garments (destined for landfill); the implication is that 52% of responses disposed of the waste textiles through other means than landfill and is therefore unaccounted for (presumably burned, buried or thrown on open ground).

4. Discussion

Age, employment category, income level, and geographical location were identified as statistically significant in understanding disposal behaviour towards PCTW, in Sri Lanka. Indeed, many of the issues revealed through our literature review in section 1 hold for Sri Lanka where PCTW is not collected separately. We compared the top five consumer issues identified from our literature review in section 1 with our survey findings:

4.1. Environmental attitudes

The high degree of variance in responses was surprising and we inferred the geographical variance to be a related to local municipal waste management practices. North Central province collected the lowest amount of waste generated per day (3%) and lowest collection rate (15%). The Eastern province, by contrast, had a collection rate of 62.9% but did not

promote a 3R programme. Ageing vehicles and unreliable timetables hampered both regions (JICA, 2016). Addressing the infrastructure and promoting 3R's of waste management (Reduce, Reuse and Recycle) to engage the public may help 'level up' environmental feelings to at least the rest of the island. This is especially important in the contexts of the generally positive relationship identified between awareness of environmental concerns and disposal behaviour (Bianchi & Birtwistle, 2010; Joung & Park-Poaps, 2013; Shim, 1995).

4.2. Textile durability

Sri Lankan consumers generally segregate PCTW before disposal and prefer to donate than sell, (Table 1). Segregation was associated with income; as income decreases, segregation decreases. One explanation may be that textiles may be used for longer and thrown out with the household rubbish. With no PCTW collection system, consumers do not perceive any residual value in worn-out textiles for recycling, reprocessing, cleaning or conversion into energy. Appropriate segregation is the first vital step towards a circular economy approach as it determines the use for it post collection. Researchers have identified textile collection encourages reutilisation of the post-consumer textiles in an economically advantageous way through reuse, upcycle and recycle in technologically developed economies (Leal Filho et al., 2019).

4.3. Fashion value

A sense of fashion value in clothing or textiles was indicated by claims of repairing before disposing of PCTW, through sewing back buttons or holding onto buttons. 50 plus age group and part-time workers also indicated an interest in selling PCTW; this had no associations with income, household numbers or geography, we inferred this as being driven largely by availability of time and life stage transition. These activities may present a case for development of a re-use shop for textiles, clothing, scraps, buttons, zips etc., such as in the UK (<http://www.reviveleeds.co.uk>), Brazil and Sweden (Leal Filho et al., 2019).

4.4. Awareness

Knowledge about textile waste management and environmental impact engages the consumer in creating a market for reuse and recycling (Leal Filho et al., 2019). Educational or public orientated programmes coupled with further research about consumer acceptance of used textiles could explore communication of value of PCTW. Identifying links within the supply chain for reuse/recycle presents opportunities for collaborations between academia, social enterprises and local governments to devise programmes that promote (i) consumer engagement with PCTW management, (ii) skills to repair/redesign and (iii) acceptance of products made from PCTW or (iv) market information systems (Gholami et al., 2018).

4.5. Disposal routes

our survey aligns with the literature review, in that 'donation', as in developed economies, was the most popular way to address PCTW, followed 'remake or recycle'. Unlike developed economies, however, the least popular mechanism was 'reselling'. This finding is interesting because it raises questions about the reasons behind donation or reselling. The choice of 'remake/recycle' and 'use until the textiles is worn out' also raises questions about how long they are used or held onto by the population and how they define clothing or textiles as 'unusable'. Our survey identified four end of life routes for PCTW (burning, burying, throwing onto open ground or landfill), whereas in the developed economies, our literature review did not identify burning of PCTW.

4.6. Policies for PCTW

Currently there are no policies in Sri Lanka for managing PCTW. Extended producer responsibility (EPR), a policy tool used for textiles has generally been used in the developed economies such as the USA and Europe. The French EPR, in place since 1 January 2007 requires all companies selling new textiles, clothing and shoes to be responsible for recycling or proper disposal (Bukhari et al., 2018; Rimmer, 2019). Sweden is set to introduce it January 2022 (Smulain, 2021) and the UK government in 2025 (EAC, 2019).

The French EPR system has nearly doubled diversion of textiles from landfill (18% in 2009 to 30% in 2017) (WRAP, 2018) but limitations remain in its implementation and connection with sustainability and the circular economy. With only 1% recycled textile fibre in the textile system (Ellen MacArthur Foundation, 2017) and growing rates of textiles discard, calls are being made for an earlier EPR introduction in the UK for 2022 (Doherty, 2019; WRAP, 2018). The French EPR system focused on eight issues to push the sustainable impacts of collection and recycling of post-consumer textiles – these align with our literature review presented in section 1: 'raising consumer awareness, connecting stakeholders through online platforms, increase container availability and accessibility, improve recycling rates, identify textiles recovery standard, improve transparency of financial and material flow rates, support research and development within this sector and encourage fashion products using pre-consumer and post-consumer materials for new products' (Rimmer, 2019). To ensure the intended circularity of the EPR system, calls are being made for design briefs to ensure recyclability of textiles (Leal Filho et al., 2019).

Reviewing Web of Science and Scopus, using keywords 'Extended producer responsibilities' and 'textiles' on May 2021, identified 28 papers, of which 24 were relevant to textiles and EPR (see Table A2, Appendix A). Top four issues were:

- how the EPR links to the circular economy (Bukhari et al., 2018; Cai & Choi, 2021; Campbell-Johnston et al., 2020; Choi, 2017; Deshmukh & Borade, 2019; Joltreau, 2018; Mazhandu et al., 2020),

- targets such as collection rates and recycling (Bukhari et al., 2018; Cai & Choi, 2021; Lakhan, 2016; Mazhandu et al., 2020; Wagner, 2013),
- international partnerships (Abbott & Sumaila, 2019; Kojima, 2020; Mazhandu et al., 2020; Zheng et al., 2017) and
- supply chains/global networks (Chan et al., 2020; Dong et al., 2019; Hickie, 2017; Wagner et al., 2013).

EPR (country/context based) raises issues of implementation pertinent to economically developing countries. Many manufacturers in global supply chains and networks are in developing economies, while the customer (the brand retailer) is in developed economies, therefore, e.g. should standardisation be considered across the whole supply chain to ensure global consistencies in the approach to textiles waste management? Should collection rates be standard along a supply chain?

Transparency, already of great importance, appears to be a crucial area to develop and maintain, e.g. in terms of who bears responsibility for the proper disposal or recycling of waste textiles. Investment in developing textile collection systems and textile recycling facilities close to the manufacture centres is important to develop to support a circular economy approach.

For Sri Lanka, waste management should play a central role in government environmental policies. Appropriate policy tools for disposal, collection and sorting of PCTW need to be developed with the intervention of the government and waste management/environmental authorities. Collective ownership between municipal councils and private sector for waste collection and sorting may lead to efficient waste management programs while reducing the operational cost (Dissanayake & Weerasinghe, 2020).

5. Conclusion

This study focused on addressing post-consumer textile waste issue in Sri Lanka. This preliminary study revealed that Sri Lankan consumers disposal behaviour for PCTW is similar to developed economies, with the exception of burying and burning PCTW (due to their local context such as waste management infrastructures). Research also finds that Sri Lanka (as many developing economies) endures an inefficient solid waste management and absence of collection and recycling technologies for post-consumer textiles. Lack of source separation of PCTW, recycling technologies, and public perception of value in PCTW represents a huge challenge in terms of market creation for PCTW and achieving sustainable consumption and production goals for 2030. Nevertheless, opportunities need to be sought to develop new business opportunities collect, sort and clean PCTW, education programmes for the public about the environmental impacts of textile waste, and appropriate policy tools for PCTW.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

UKRI RE/GCRF University of Leeds Block Grant 2019-2020.

ORCID

Pammi Sinha  <http://orcid.org/0000-0003-4384-9429>
D. G. K. Dissanayake  <http://orcid.org/0000-0002-0498-3353>

References

- Bianchi, C., & Birtwistle, G. (2010). Sell, give away, or donate: An exploratory study of fashion clothing disposal behaviour in two countries. *The International Review of Retail, Distribution and Consumer Research*, 20(3), 353–368. <https://doi.org/10.1080/09593969.2010.491213>
- Bianchi, C., & Birtwistle, G. (2012). Consumer clothing disposal behaviour: A comparative study. *International Journal of Consumer Studies*, 36(3), 335–341. <https://doi.org/10.1111/j.1470-6431.2011.01011.x>
- Birtwistle, G., & Moore, C. M. (2007). Fashion clothing – Where does it all end up? *International Journal of Retail & Distribution Management*, 35(3), 210–216. <https://doi.org/10.1108/09590550710735068>
- Bukhari, M. A., Carrasco-Gallego, R., & Ponce-Cueto, E. (2018). Developing a national programme for textiles and clothing recovery. *Waste Management & Research: The Journal of the International Solid Wastes and Public Cleansing Association, ISWA*, 36(4), 321–331. <https://doi.org/10.1177/0734242X18759190>
- Cai, Y.-J., & Choi, T.-M. (2021). Extended producer responsibility: A systematic review and innovative proposals for improving sustainability. *IEEE Transactions on Engineering Management*, 68(1), 272–288. <https://doi.org/10.1109/TEM.2019.2914341>
- Campbell-Johnston, K., Calisto Friant, M., Thapa, K., Lakerveld, D., & Vermeulen, W. J. (2020). How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective. *Journal of Cleaner Production*, 270, 122042. <https://doi.org/10.1016/j.jclepro.2020.122042>
- Central Bank of Sri Lanka. (2020). *Economic & Social Statistics of Sri Lanka - 2020*. Statistics Department, Central Bank of Sri Lanka.
- Chan, H.-L., Choi, T.-M., Cai, Y.-J., & Shen, B. (2020). Environmental taxes in newsvendor supply chains: A mean-downside-risk analysis. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 50(12), 4856–4869. <https://doi.org/10.1109/TSMC.2018.2870881>
- Choi, T. (2017). Environmental impact of voluntary extended producer responsibility: The case of carpet recycling. *Resources, Conservation and Recycling*, 127, 76–84. <https://doi.org/10.1016/j.resconrec.2017.08.020>
- Deshmukh, Y. P., & Borade, A. B. (2019). Developing the plastic green supply chain management framework and implementation strategy to deliver the sustainability needs of plastic processing industries. *International Journal of Mechanical and Production Engineering Research and Development*, 9(3), 903–922. <https://doi.org/10.24247/ijmperdjun201999>
- Dissanayake, D. G. K., & Weerasinghe, D. (2020). Managing post-industrial textile waste: Current status and prospects for Sri Lanka. *Journal of the Textile Institute*, 1–7. <https://doi.org/10.1080/00405000.2020.1845461>
- Dissanayake, D. G. K., Weerasinghe, D. U., Thebuwanage, L. M., & Bandara, U. A. A. N. (2021). An environmentally friendly sound insulation material from post-industrial textile waste and natural rubber. *Journal of Building Engineering*, 33, 101606. <https://doi.org/10.1016/j.jobbe.2020.101606>
- Dissanayake, D. G. K., Weerasinghe, D. U., Wijesinghe, K. A. P., & Kalpage, K. M. D. M. P. (2018). Developing a compression moulded thermal insulation panel using postindustrial textile waste. *Waste Management (New York, N.Y.)*, 79, 356–361. <https://doi.org/10.1016/j.wasman.2018.08.001>

- Doherty, J. (2019). TRA calls for 2022 timetable for textile EPR [WWW Document]. <https://www.letsrecycle.com/news/latest-news/tra-calls-for-2022-deadline-for-textile-epr/>
- Domina, T., & Koch, K. (1999). Consumer reuse and recycling of post-consumer textile waste. *Journal of Fashion Marketing and Management: An International Journal*, 3(4), 346–359. <https://doi.org/10.1108/eb022571>
- Dong, Y., Zhang, F., & Fu, L. (2019). Ecological design: The role of extended producer responsibility system. *Journal of Coastal Research*, 93(sp1), 354. <https://doi.org/10.2112/S193-047.1>
- EAC. (2019). Fixing fashion: clothing consumption and sustainability [WWW Document]. <https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1952/report-summary.html>
- Ellen MacArthur Foundation. (2017). A new textiles economy: Redesigning fashion's future.
- Gholami, R., Molla, A., Goswami, S., & Brewster, C. (2018). Green information systems use in social enterprise: The case of a community-led eco-localization website in the West Midlands region of the UK. *Information Systems Frontiers*, 20(6), 1345–1361. <https://doi.org/10.1007/s10796-016-9733-z>
- Ha-Brookshire, J. E., & Hodges, N. N. (2009). Socially responsible consumer behavior? Cloth. *Textile Research Journal*, 27(3), 179–196. <https://doi.org/10.1177/0887302X08327199>
- Hawley, J. M. (2006). Digging for diamonds: A conceptual framework for understanding reclaimed textile products. *Clothing and Textiles Research Journal*, 24(3), 262–275. <https://doi.org/10.1177/0887302X06294626>
- Hickle, G. (2017). Extending the boundaries: An assessment of the integration of extended producer responsibility within corporate social responsibility. *Business Strategy and the Environment*, 26(1), 112–124. <https://doi.org/10.1002/bse.1908>
- Hole, G., & Hole, A. S. (2019). Recycling as the way to greener production: A mini review. *Journal of Cleaner Production*, 212, 910–915. <https://doi.org/10.1016/j.jclepro.2018.12.080>
- JICA. (2016). Data Collection Survey on Solid Waste Management in Democratic Socialist Republic of Sri Lanka Final Report Democratic Socialist Republic of Sri Lanka Japan International Cooperation Agency (JICA) Ten (10) Priority Local Authorities 22.
- Joltreau, E. (2018). Pricing products' negative externalities at end-of-life using eco-modulation: Discussion from case studies. *Economics and Policy of Energy and The Environment*, (1), 149–172. <https://doi.org/10.3280/EFE2018-001007>
- Joung, H. M. (2014). Fast-fashion consumers' post-purchase behaviours. *International Journal of Retail & Distribution Management*, 42(8), 688–697. <https://doi.org/10.1108/IJRDM-03-2013-0055>
- Joung, H. M., & Park-Poaps, H. (2013). Factors motivating and influencing clothing disposal behaviours. *International Journal of Consumer Studies*, 37(1), 105–111. <https://doi.org/10.1111/j.1470-6431.2011.01048.x>
- Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018). What a waste 2.0: A global snapshot of solid waste management to 2050. *Urban Development Series*. <https://doi.org/10.1596/978-1-4648-1329-0>
- Kojima, M. (2020). The impact of recyclable waste trade restrictions on producer recycling activities. *International Journal of Automation Technology*, 14(6), 873–881. <https://doi.org/10.20965/ijat.2020.p0873>
- Koszewska, M., Rahman, O., & Dyczewski, B. (2020). Circular fashion – Consumers' attitudes in cross-national study: Poland and Canada. *Autex Research Journal*, 20(3), 327–337. <https://doi.org/10.2478/aut-2020-0029>
- Laitala, K. (2014). Consumers' clothing disposal behaviour – A synthesis of research results. *International Journal of Consumer Studies*, 38(5), 444–457. <https://doi.org/10.1111/ijcs.12088>
- Lakhan, C. (2016). The relationship between municipal waste diversion incentivization and recycling system performance. *Resources, Conservation and Recycling*, 106, 68–77. <https://doi.org/10.1016/j.resconrec.2015.11.010>
- Lang, C., Armstrong, C. M., & Brannon, L. A. (2013). Drivers of clothing disposal in the US: An exploration of the role of personal attributes and behaviours in frequent disposal. *International Journal of Consumer Studies*, 37(6), 706–714. <https://doi.org/10.1111/ijcs.12060>
- Lang, C., & Zhang, R. (2019). Second-hand clothing acquisition: The motivations and barriers to clothing swaps for Chinese consumers. *Sustainable Production and Consumption*, 18, 156–164. <https://doi.org/10.1016/j.spc.2019.02.002>
- Leal Filho, W., Ellams, D., Han, S., Tyler, D., Boiten, V. J., Paco, A., Moora, H., & Balogun, A. L. (2019). A review of the socio-economic advantages of textile recycling. *Journal of Cleaner Production*, 218, 10–20. <https://doi.org/10.1016/j.jclepro.2019.01.210>
- Lehner, M., Mont, O., Mariani, G., & Mundaca, L. (2020). Circular economy in home textiles: Motivations of IKEA consumers in Sweden. *Sustainability*, 12(12), 5030. <https://doi.org/10.3390/su12125030>
- Mazhandu, Z. S., Muzenda, E., Mamvura, T. A., Belaid, M., & Nhubu, T. (2020). Integrated and consolidated review of plastic waste management and bio-based biodegradable plastics: Challenges and opportunities. *Sustainability*, 12(20), 8360. <https://doi.org/10.3390/su12208360>
- McNeill, L. S., Hamlin, R. P., McQueen, R. H., Degenstein, L., Garrett, T. C., Dunn, L., & Wakes, S. (2020a). Fashion sensitive young consumers and fashion garment repair: Emotional connections to garments as a sustainability strategy. *International Journal of Consumer Studies*, 44(4), 361–368. <https://doi.org/10.1111/ijcs.12572>
- McNeill, L. S., Hamlin, R. P., McQueen, R. H., Degenstein, L., Wakes, S., Garrett, T. C., & Dunn, L. (2020b). Waste not want not: Behavioural intentions toward garment life extension practices, the role of damage, brand and cost on textile disposal. *Journal of Cleaner Production*, 260, 121026. <https://doi.org/10.1016/j.jclepro.2020.121026>
- Morgan, L. R., & Birtwistle, G. (2009). An investigation of young fashion consumers' disposal habits. *International Journal of Consumer Studies*, 33(2), 190–198. <https://doi.org/10.1111/j.1470-6431.2009.00756.x>
- Nencková, L., Pecáková, I., & Šauer, P. (2020). Disposal behaviour of Czech consumers towards textile products. *Waste Management (New York, N.Y.)*, 106, 71–76. <https://doi.org/10.1016/j.wasman.2020.03.001>
- Norum, P. S. (2017). Towards sustainable clothing disposition: Exploring the consumer choice to use trash as a disposal option. *Sustainability*, 9(7), 1187. <https://doi.org/10.3390/su9071187>
- Nørup, N., Pihl, K., Damgaard, A., & Scheutz, C. (2019). Replacement rates for second-hand clothing and household textiles – A survey study from Malawi, Mozambique and Angola. *Journal of Cleaner Production*, 235, 1026–1036. <https://doi.org/10.1016/j.jclepro.2019.06.177>
- Norusis, M. J. (2008). *SPSS 16.0 guide to data analysis*. 2nd ed. Prentice Hall.
- Paço, A., Leal Filho, W., Ávila, L. V., & Dennis, K. (2020). Fostering sustainable consumer behavior regarding clothing: Assessing trends on purchases, recycling and disposal. *Textile Research Journal*, 91(3–4), 373–384. <https://doi.org/10.1177/0040517520944524>
- Rezaei Arangdad, S., Thoney-Barletta, K., Joines, J., & Rothenberg, L. (2019). Influence of demographics and motivational factors on US consumer clothing and shoes disposal behavior. *Research Journal of Textile and Apparel*, 23(3), 170–188. <https://doi.org/10.1108/RJTA-08-2018-0051>
- Rimmer, L. (2019). Going the textiles mile: Are you compliant with French Textiles Regulations? [WWW Document]. <https://www.valpak.co.uk/news-blog/blog/going-the-textiles-mile-are-you-compliant-with-french-textiles-regulations>
- Shim, S. (1995). Environmentalism and consumers' clothing disposal patterns: An exploratory study. *Clothing and Textiles Research Journal*, 13(1), 38–48. <https://doi.org/10.1177/0887302X9501300105>
- Shirvanimoghaddam, K., Czech, B., Wiącek, A. E., Ćwikła-Bundyra, W., & Naebe, M. (2019). Sustainable carbon microtube derived from cotton waste for environmental applications. *Chemical Engineering Journal and the Biochemical Engineering Journal*, 361, 1605–1616. <https://doi.org/10.1016/j.cej.2018.11.157>
- Smulain, M. (2021). WRAP and retail back EPR for textiles [WWW Document]. <https://www.mrw.co.uk/news/wrap-and-retail-back-epr-for-textiles-18-12-2020/>
- TRA. (2020). Used clothing/textiles global market update [WWW Document]. <https://www.textile-recycling.org.uk/used-clothing-textiles-global-market-update/>
- Vehmas, K., Raudaskoski, A., Heikkilä, P., Harlin, A., & Mensonen, A. (2018). Consumer attitudes and communication in circular fashion.

- Journal of Fashion Marketing and Management: An International Journal*, 22(3), 286–300. <https://doi.org/10.1108/JFMM-08-2017-0079>
- Wagner, T. P., Toews, P., & Bouvier, R. (2013). Increasing diversion of household hazardous wastes and materials through mandatory retail take-back. *Journal of Environmental Management*, 123, 88–97. <https://doi.org/10.1016/j.jenvman.2013.03.020>
- Wagner, T. P. (2013). Examining the concept of convenient collection: An application to extended producer responsibility and product stewardship frameworks. *Waste Management*, 33(3), 499–507. <https://doi.org/10.1016/j.wasman.2012.06.015>
- Weber, S., Lynes, J., & Young, S. B. (2017). Fashion interest as a driver for consumer textile waste management: Reuse, recycle or disposal. *International Journal of Consumer Studies*, 41(2), 207–215. <https://doi.org/10.1111/ijcs.12328>
- WRAP. (2018). UK textiles extended producer responsibility [WWW Document]. <https://archive.wrap.org.uk/content/uk-textiles-extended-producer-responsibility>
- Yin, R. K. (2013). *Case study research: Design and methods*. 3rd ed. SAGE Publications Inc.
- Young Lee, J., Halter, H., Johnson, K. P., & Ju, H. (2013). Investigating fashion disposition with young consumers. *Young Consumers*, 14(1), 67–78. <https://doi.org/10.1108/17473611311305494>
- Zheng, X., Xu, F., & Feng, L., (2017) Analysis of driving factors for Extended Producer Responsibility by using interpretative structure modelling (ISM) and analytic network process (ANP). *Sustainability (Switzerland)*, 9(4), 540. <https://doi.org/10.3390/su9040540>
- Zhang, L., Wu, T., Liu, S., Jiang, S., Wu, H., & Yang, J. (2020). Consumers' clothing disposal behaviors in Nanjing. *Journal of Cleaner Production*, 276, 123184. <https://doi.org/10.1016/j.jclepro.2020.123184>
- Žurga, Z., Hladnik, A., & Tavčer, P. F. (2015). Environmentally sustainable apparel acquisition and disposal behaviours among Slovenian consumers. *Autex Research Journal*, 15(4), 243–259. <https://doi.org/10.1515/aut-2015-0044>

Appendix A

Table A1. Disposal behaviour towards textiles.

No.	Authors	Method	Country	Findings	Focus	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
1	(Koszevska et al., 2020)	Survey	Canada & Poland	Cross country comparison of the differences around ecolabeling, choosing to consume less, clothing durability and impact on air pollution	Ecolabel, lower consumption, durability, environmental impact	Environmental attitudes	Textile durability	Awareness	Transparency	
2	(Paço et al., 2020)	Survey	International	Need for raising awareness about sustainable clothing consumption	Awareness rising	Awareness				
3	(Hole & Hole, 2019)	Review	N/A	Policies currently in place for other recyclates could be transferred to textiles, tax relief and rewarding policies, e.g. labelling for recycling.	Transfer current recycle policies to textiles	Policies				
4	(McNeill et al., 2020b)	Survey	South Korea	Need for better demographic understanding of consumer value perception for clothing	More targeted solutions needed	Consumer knowledge				
5	(Lehner et al., 2020)	Survey and Interviews	Sweden	IKEA: Sweden. Most often – donate or discard. Environmental concerns, convenience and economics are important in considering disposal options.	Need to convince for circular practices and raise awareness	Convivence	Awareness	Economics		
6	(Nencková et al., 2020)	Survey	Czech Republic	Gender, age, education, income, and number of household members significant for textile waste separation – not number of children	Demographics in textile waste separation	Socio-demographics	Awareness	Children		
7	(McNeill et al., 2020a)	Survey	South Korea	Young, fashion sensitive consumers dispose more frequently but will repair items they regard to hold fashion identity	Fashion identity and value	Fashion value				
8	(Rezaei Arangdad et al., 2019)	Survey	USA	1. Gender, income, marital status and type of dwelling have an effect on whether the textile is recycled. 2. Convenience factors motivate recycling more than economic	Demographics in textile waste recycling	Socio-demographics	Children	Space	Convenience	Economics
9	(Vehmas et al., 2018)	Interviews	Finland	Want transparency in materials, processes and environment impact. Communication should be timed, using multiple channels and pay attention to shopping experience-value	Transparency, communication and shopping experience	Transparency	Awareness	Fashion value		
10	(Norum, 2017)	Interviews	USA	Need to create awareness and provide assurance to encourage alternative disposal modes	Mechanisms for preventing textiles going to landfill	Prevent landfill	Raise awareness	Assure alternative disposal		
11	(Weber et al., 2017)	Survey	Canada	Fashion interest and shopping frequency were assigned a fashion index (FI) value. Majority donate and dispose of unwanted clothes. High FI more interested and more likely to participate in alternative methods (e.g. resell, swap, and take back) instead of dispose. Textile consumption cannot be directly equated with textile waste	Knowledge about FI – to tailor disposal strategies. Textile consumption not directly related to textile waste.	Consumer knowledge	Fashion value			
12	(Žurga et al., 2015)	Survey	Slovenia	Differences found with frequency of apparel recycling in consumers with or without an apparel bank nearby.	Convenience as important as socio demographic factors.	Convenience	Socio demographic			
13	(Laitala, 2014)	Literature review	Thirty years (1984–2014)	Consumers prefer to reuse rather than to dispose of them, but convenience is paramount. Common disposal reasons for apparel: wear & tear, poor fit & fashion or boredom, lack of storage space.	Common reasons to dispose: wear and tear, fashion, fit, boredom, space.	Textile durability	Fashion value	Consumer knowledge	Space	Research methods
14	(Morgan & Birtwistle, 2009)	Interviews and survey	UK	Lack of understanding about consumption and disposal behaviour on environment	Consumption and disposal behaviour	Awareness				
15	(Domina & Koch, 1999)	Survey	USA	Age, family size, and income as significant predictors of recycling activity.	Extend curbside collection	Convenience				
16	(Zhang et al., 2020)	Survey	China	Average lifespan 3.75 years. Differed according to gender, age, income. Lifespan dependant on wear and tear.	Lifespan – longer than UK due to wear out.	Textile durability	Disposal route	Socio-demographic		
17	(Joung, 2014)	Survey	USA			Disposal route	Fashion value			

(continued)

Table A1. Continued.

No.	Authors	Method	Country	Findings	Focus	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5			
				Fast-fashion purchase was positively related to disposing and hoarding, but negatively related to participation in recycling. Apparel hoarding was positively related to recycling.	Link between participation in recycling and environmental attitudes			Environmental attitudes					
18	(Shim, 1995)	Survey and interviews	USA	Environmental attitude had strong influence on disposal patterns than recycling behaviour. Female students and older students were more likely to choose environmentally oriented disposal methods.	Influence of gender, age, and ethnicity on clothing disposal patterns.	Environmental attitudes	Socio-demographic	Cultural norms					
19	(Birtwistle & Moore, 2007)	Interviews	Scotland	Consumers have lack of understanding on how consumption behaviours affect the environment and unaware of the need for clothing recycling.	Consumer disposal habits and how to increase sustainable consumption	Awareness							
20	(Morgan & Birtwistle, 2009)	Interviews and survey	Scotland	Young consumers have lack of understanding on how consumption behaviours affect the environment and unaware of the need for clothing recycling.	Young consumer disposal habits	Awareness							
21	(Ha-Brookshire & Hodges, 2009)	Interviews	USA	Primary motivation for donation behaviour is the need to create space in the closet. The threat of feelings of guilt played a significant role in the decision.	Used clothing donation behaviours.	Space	Donation						
22	(Bianchi & Birtwistle, 2010)	Survey	Scotland and Australia	Donating to charities was a common recycling behaviour. Other forms of disposal are selling and giving away to family or friends.	Disposal behaviours	Donation	Disposal routes						
23	(Bianchi & Birtwistle, 2012)	Survey	Australia and Chile	Consumer awareness of the environment and age affect donating behaviour. Consumer recycling behaviour is a strong and direct driver of donating to charity.	Disposal behaviour	Awareness	Donation						
24	(Joung & Park-Poaps, 2013)	Survey	USA	Resale and donation behaviours were explained by environmental and economic concerns. Family subjective norms influenced environmentally motivated resale and donation behaviours	Factors influencing disposal behaviour	Environmental attitudes	Economics	Cultural norms					
25	(Lang et al., 2013)	Survey	USA	Fashion trend sensitivity, shopping frequency, higher incomes, younger age groups, quality and being female are positively correlated with frequent clothing disposal. Price consciousness was negatively related.	Drives of clothing waste and influence on demographic factors and personal attributes	Fashion value	Economics						
26	(Young Lee et al., 2013)	Essay	USA	Participants engaged in multiple fashion disposition behaviours including donation, selling, repurposing, and swap. Fashionability, physical condition, and social responsibility were influencing factors.	Young consumer fashion disposition behaviour	Fashion value	Textile durability	Social responsibility					
27	(Joung, 2014)	Survey	USA	Fast-fashion purchase is positively related to disposing and hoarding, negatively related to participation in recycling.	Post-purchase behaviour.	Environmental attitudes	Fashion value						
28	(Lang & Zhang, 2019)	Survey	China	Social shopping value and perceived enjoyment have a positive influence on the intention to swap. There are negative influences of performance risk and social risk on intention to swap clothing items.	Motivation and barriers for cloth swaps	Fashion value	Cultural norms	Textile durability					
29	(Nørup et al., 2019)	Survey	Malawi, Mozambique and Angola	Replacement rates are found to be lower than expected.	Replacement rates of second-hand clothing and household textiles		Textile durability						
Themes													
Convenience	Awareness	Consumer knowledge	Socio-demographics	Environmental attitudes	Fashion value	Children	Textile durability	Disposal routes	Policies	Transparency	Space	Research methods	Economics
3	7	3	4	2	5	2	3	3	1	1	2	1	2

Table A2. EPR issues in textiles.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page start	Page end	DOI	Findings	issue 1	issue 2	issue 3	issue 5	issue 6	issue 7	
1 Villegas Pinuer F.J., Llonch Andreu J., Belbeze P.L., Valenzuela- Fernandez L.	Waste management: The disconnection between normative and SMEs reality	2021	Sustainability (Switzerland)	13	4	1787	1	20	10.3390/ su13041787	The results show the practical company size limitations of SMEs in complying with the waste law, the lack of traceability in the waste management system, and the need for economic support and technical assistance to improve the use and management of sustainable raw materials. In addition to systematically exploring the state-of-the-art research within the context of EPR, we investigate pertinent issues, such as the implementation of EPR, EPR management systems, supply chain management under EPR, and EPR-related operations (such as end-of-life product management and design for recyclability). We highlight some EPR-related innovative measures and proposals in five areas: namely policy, product, process, supply chain, and technology. Finally, we discuss future research and propose a concluding picture of how EPR can help establish innovative operational measures to improve sustainability. ©	issue 1	traceability	economic support	technical assistance	issue 5	supply chain management under EPR	end-of-life product management and design for recyclability
2 Cai Y.-J., Choi T.-M.	Extended Producer Responsibility: A Systematic Review and Innovative Proposals for Improving Sustainability	2021	IEEE Transactions on Engineering Management	68	1	8731754	272	288	10.1109/TEM. 2019.2914341	In addition to systematically exploring the state-of-the-art research within the context of EPR, we investigate pertinent issues, such as the implementation of EPR, EPR management systems, supply chain management under EPR, and EPR-related operations (such as end-of-life product management and design for recyclability). We highlight some EPR-related innovative measures and proposals in five areas: namely policy, product, process, supply chain, and technology. Finally, we discuss future research and propose a concluding picture of how EPR can help establish innovative operational measures to improve sustainability. ©	issue 1	targets for collection and recycling rates	operations management	implementation of EPR	EPR management systems,	supply chain management under EPR	end-of-life product management and design for recyclability
3 Chan H.-L., M. Cai Y.-J., Shen B.	Environmental Taxes in Newsvendor Supply Chains: A Mean-Downside- Risk Analysis	2020	IEEE Transactions on Systems, Man, and Cybernetics: Systems	50	12	8525439	48564869	10.1109/TSMC. 2018.2870881	We highlight how the retailer's risk attitude and the number of consumer returns affect: 1) supply chain operations; 2) performances of the environmental taxes; and 3) supply chain coordination (i.e. optimization). To be specific, we derive the optimal inventory decisions of the retailer when she is risk neutral and risk averse, respectively. Our analytical results show that the two-part tariff contract can achieve coordination for the case with a risk neutral retailer only, while markdown sponsor (MDS) contract and revenue-sharing policy (RSP) can achieve coordination for both risk neutral or risk averse retailer cases. Besides, we reveal that the examined contracts can coordinate the supply chain with a risk neutral retailer more	issue 1	inventory	retailer risk attitude	retailer risk attitude	issue 5	supply chain management under EPR	end-of-life product management and design for recyclability	

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue 5	issue 6	issue 7	
4 Campbell-Johnston K, Calisto Friant M, Thapa K, Lakerveld D, Vermeulen W.J.V.	How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective	2020	Journal of Cleaner Production	270	122042	10.1016/j.jclepro.2020.122042			flexibly than that with a risk averse retailer. Finally, by comparing between the MDS contract and RSP, we find that the environmental taxes and the consumer returns will affect the coordination mechanism differently toward the risk neutral and risk averse retailers. Impacts brought by the consumer returns are also explored. © 2015 IEEE.	limited circularity and sustainability outcomes	continuous improvement of recovery and sustainability targets beyond a single product life cycle	inclusive governance system,	sufficiency strategies, e.g. design for durability			
5 Mazhandu Z.S., Muzenda E., Mamura T.A., Balaid M., Nthubu T.	Integrated and consolidated review of plastic waste management and bio-based biodegradable plastics: Challenges and opportunities	2020	Sustainability (Switzerland)	12	20	8360	1 57 10.3390/su12208360		Our analysis reveals seven central issues concerning the EPR system, resulting in limited circularity and sustainability outcomes, despite high material recovery levels. To address these issues we recommend the continuous improvement of recovery and sustainability targets beyond a single product life cycle, a more transparent and inclusive governance system, as well as a greater focus on sufficiency strategies, e.g. design for durability and a broader transformation of transport models. This paper adds a practical understanding of the capacity of EPR to contribute to CE. © 2020 The Authors	characterisation of materials to ensure environmentally neutral	investment in waste management	recycling rates	reclaiming	bans on negatively impacting materials	country-specific scientific evidence is necessary	global coalitions
6 Kojima M.	The impact of recyclable waste trade restrictions on producer recycling activities	2020	International Journal of Automation Technology	14	6	873	881 10.20965/ijat.2020.p0873		In conclusion, governments from all countries and stakeholders should work to strengthen waste management infrastructure in low-and middle-income countries while extended producer responsibility (EPR) and deposit refund schemes (DPRs) are important add-ons to consider in plastic waste management, as they have been found to be effective in Australia, France, Germany, and Ecuador. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	international policies						

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue 5	issue 6	issue 7
7 Dong Y., Zhang F., Fu L.	Ecological Design: The Role of Extended Producer Responsibility System	2019	Journal of Coastal Research	93	sp1		354-361	10.2121/5193-047.1	environmentally sound recycling. © 2020 Global Research Online. All rights reserved. The results show that as key elements of EPR, government regulation and incentives, corporate internal environment management can effectively promote the concept and behavior of ecological design of manufacturing enterprises; but consumer demand pressure cannot significantly affect the implementation of ecological design. © Coastal Education and Research Foundation, Inc. 2019.	industry-government partnerships	consumer demand pressure not enough to get implementation of ecological design				
8 Abbott J.K., Sumaila U.R.	Reducing marine plastic pollution: Policy insights from economics	2019	Review of Environmental Economics and Policy	13	2	rez007	327-336	10.1093/resp/rez007	We examine the economic literature on waste management and integrated environmental policy to assess how particular policies target these individual pathways and can efficiently reduce flows of plastics into waterways. These policies include production/retail bans and standards, extended producer responsibility, price-based policies such as advance disposal fees and two-part instruments, and interventions grounded in behavioural economics and psychology. We also consider the applicability of these policies in coastal developing nations that often rely upon the informal sector for waste management services. We conclude by identifying important issues for future research. © 2019 The Author(s) Oxford University Press on behalf of the Association of Environmental and Resource Economists. All rights reserved. For permissions, please email: journals.permissions@oup.com.	production/retail bans and behavioural standards; EPR, price-based policies such as advance disposal fees and two-part instruments, and interventions grounded in	economics and psychology.	applicability in developing nations reliant on informal waste picker sector			
9 Prata J.C., Patrício Silva A.L., da Costa J.P., Mouneyrac C., Walker T.R., Duarte A.C., Rocha-Santos T.	Solutions and integrated strategies for the control and mitigation of plastic and microplastic pollution	2019	International Journal of Environmental Research and Public Health	16	13	2411	10.3390/ijerph16132411		In this review paper, we discuss current practices to improve life cycle and waste management of plastics that can be implemented to reduce health and environmental impacts of plastics and reduce plastics pollution. Ten recommendations for stakeholders to reduce	systems approach	multi-stakeholder				

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue	issue 5	issue 6	issue 7
10Deshmukh Y.P., Bonade A.B.	Developing the plastic green supply chain management framework and implementation strategy to deliver the sustainability needs of plastic processing industries	2019	International Journal of Mechanical and Production Engineering Research and Development	9	3	IJMPERD JUN201999	903-922	10.24247/ijmperdjun201999	plastic pollution include (1) regulation of production and consumption; (2) eco-design; (3) increasing the demand for recycled plastics; (4) reducing the use of plastics; (5) use of renewable energy for recycling; (6) extended producer responsibility over waste; (7) improvements in waste collection systems; (8) prioritization of recycling; (9) use of bio-based and biodegradable plastics; and (10) improvement in recyclability of e-waste. © 2019 by the authors. Licensee MDPI, Basel, Switzerland.	Performance metrics play an important role in setting plastic green supply chain management framework, evaluating performance, and identifying future course of action. The proposed framework for the plastic green supply chain (PGSCMF) outlines the taxonomy and implementation of green supply chain practices in real business case studies. The framework will act as a flexible reference tool for managers in the plastics companies of small and micro scale to bring greater continuity to undertake the necessary improvements at a very local and specific level. © TjPRC Pvt. Ltd.	green supply chain management framework					
11Bukhari M.A., Carrasco-Gallego R., Ponce-Cueto E.	Developing a national programme for textiles and clothing recovery	2018	Waste Management and Research	36	4		321-331	10.1177/0734242218759190	The EPR policy shows a great potential to identify new markets for 'reuse' and to improve the textiles waste sector. Such an EPR policy also could drive societies to financially support innovation and research to provide feasible solutions for fashion producers to adopt eco-design and design for recycling practices. This paper provides guidance for policy makers, shareholders, researchers and practitioners interested in diverting post-consumer textiles and clothing waste from landfills and promoting circular textiles transition. © 2018, © The Author(s) 2018.	Performance metrics play an important role in setting plastic green supply chain management framework, evaluating performance, and identifying future course of action. The proposed framework for the plastic green supply chain (PGSCMF) outlines the taxonomy and implementation of green supply chain practices in real business case studies. The framework will act as a flexible reference tool for managers in the plastics companies of small and micro scale to bring greater continuity to undertake the necessary improvements at a very local and specific level. © TjPRC Pvt. Ltd.	'reuse' stream reliant on market conditions	financially support innovation and researches.	eco-design and design for recycling practice			

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue	issue 5	issue 6	issue 7
12 Joltreau E.	Pricing products' negative externalities at end-of-life using eco-modulation: Discussion from case studies	2018	Economics and Policy of Energy and the Environment	20181			149-172	10.3280/EFE2018-001007	In this paper, I open the discussion whether eco-modulation in the framework of collective responsibility (EPR) could be able to spur the environmentally sound products at end of life. The European Commission is now planning to revise its directive Dir. 1994/62/EC to provide guiding principles on eco-modulation for packaging for all EPR organisations across Europe. In general, eco-modulation is becoming increasingly relevant on the European scene. Therefore, I aim at reflecting on the efficiency of eco-modulation in addressing products' negative externalities at end-of-life, by analysing early feedbacks and data from French EPR systems. © 2018 Franco Angeli Edizioni. All rights reserved.	collective system: producers pay a fee per quantity of items placed on the market to a central organisation T-compliance fee represents the average cost of treating waste for a given product stream.	individual internalisation of products' end-of-life externalities.	ecomodulation to EPR collective systems: penalising or rewarding individual design choices of producers, using financial incentives.	The European Commission is now planning to revise its 1994/62/EC to provide guiding principles on eco-modulation for packaging for all EPR organisations across Europe	In general, eco-modulation is becoming increasingly relevant on the European scene	eco-design	
13 Wiesmeth H., Häckl D.	Integrated environmental policy: A review of economic analysis	2017	Waste Management and Research	35	4		332-345	10.1177/073424216672319	This article therefore investigates – mostly from a practical point of view – constitutive elements, which are necessary for a holistic policy to serve as a well-functioning allocation mechanism. As these constitutive elements result from a careful 'integration' of the environmental commodities into the economic allocation problems, we refer to these policies as 'integrated environmental policies'. The article also discusses and illustrates the main steps of designing such a policy – for waste electrical and electronic equipment and a (possible) ban of Glyphosat in agriculture. As these policies are dependent on economic and political stability with environmental awareness sufficiently developed, the article addresses mostly waste management policies in highly industrialised countries. © 2016, © The Author(s) 2016.	'integrated environmental policy' result from a careful 'integration' of environmental commodities into the economic allocation	constitutive elements these policies are dependent on economic and political stability with environmental awareness sufficiently developed, economic developed,					

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue	issue 5	issue 6	issue 7
14Zheng X., Xu F., Feng L.	Analysis of driving factors for Extended Producer Responsibility by using interpretative structure modelling (ISM) and analytic network process (ANP)	2017	Sustainability (Switzerland)	9	4	540	10.3390/s9040540		exploring the hierarchical relationship among the driving factors of EPR in China and by identifying and ranking the factors that are critical in EPR implementation. As important managerial conclusions, research results show that EPR-related laws and regulations, the consciousness of senior executives, and corporate image are the three most important driving factors of EPR implementation. © 2017 by the authors. link with CSR recommendations as to how CSR practices can more effectively recognize product management strategies as well as how EPR policy can be enhanced to further embed product end-of-life management strategies and activities within the CSR activities of firms. Copyright © 2015 John Wiley & Sons, Ltd and EPR Environment. Copyright © 2015 John Wiley & Sons, Ltd and EPR Environment	developing countries	hierarchical relationship among the driving factors of EPR	management attitudes and knowledge important.				
15Hickle G.	Extending the Boundaries: An Assessment of the Integration of Extended Producer Responsibility Within Corporate Social Responsibility	2017	Business Strategy and the Environment	26	1		112-124	10.1002/bse.1908	explores the relationship between EPR and CSR, and how they can be integrated. It discusses the challenges of EPR implementation and provides recommendations for how EPR can be effectively integrated with CSR. © 2017 John Wiley & Sons, Ltd and EPR Environment	link with CSR						
16Choi T.	Environmental impact of voluntary extended producer responsibility: The case of carpet recycling	2017	Resources, Conservation and Recycling		127		76-84	10.1016/j.resconrec.2017.08.020	simulation compares the life-cycle impacts between a vertically integrated recycling system of production of reclaimed nylon 6 fiber and an out-sourced recycling system of production of recycled carpet padding. The result demonstrates the benefits of energy savings and greenhouse gas emissions significantly differ according to recycling systems. A large portion of environmental benefits is attributed to the energy savings in the process of reclaiming nylon 6 of the vertically integrated system. © 2017 Elsevier B.V.	market-based EPR approach	public and private sector collaborations	vertically integrated or out-sourced recycling systems.	environmental benefits as the vertically integrated recycling system			
17Turner J.M., Nugent L.M.	Charging up Battery Extended Producer Responsibility for Single-Use Batteries in the European Union, Canada, and the United States	2016	Journal of Industrial Ecology	20	5		1148-1158	10.1111/jiecl.12351	considers how EPR policies for single-use batteries integrate performance requirements such as collection rates, recycling efficiencies, and best available techniques. It argues that for such policies to be effective, they need to be extended to address waste collection practices, the life cycle consequences of EOL	integrative EPR policies						

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue	issue 5	issue 6	issue 7
18Lakhan C	The relationship between municipal waste diversion incentivization and recycling system performance	2016	Resources Conservation and Recycling	106		68	77	10.1016/j.resconrec.2015.11.010	management and the quality of recovered materials. Such strategies are relevant to EPR policies for other products with marginal secondary value, including some textiles, plastics, and other types of electronic waste. © 2015 by Yale University	funding mechanisms for EPR	Packaging fees remitted by packaging producer:	no statistically significant relationship between municipal incentives, recycling rates or program costs.				
19Hvass K.K.	Post-retail responsibility of garments – A fashion industry perspective	2014	Journal of Fashion Marketing and Management	18	4	413	430	10.1108/JFMM-01-2013-0005	The findings demonstrate that post-retail responsibility of fashion is an emerging field in the fashion industry that offers several business opportunities to fashion companies, but also requires rethinking of existing value propositions and engagement of a wider stakeholder group in order to find sustainable solutions for garments' end of life. The field is still new with limited best practice, however, two main strategies of how fashion companies address post-retail responsibility of their products can be distinguished: second hand retailing and product take-back schemes.	reuse and recycling of garments from the fashion industry's perspective.	post-retail responsibility	value propositions and engagement of a wider stakeholder group	second hand retailing product take-back schemes.			
20Lai K.-H., Wong C.W.Y., Venus Lun Y.H.	The role of customer integration in extended producer responsibility: A study of Chinese export manufacturers	2014	International Journal of Production Economics	147	PART B	284	293	10.1016/j.ijpe.2013.06.028	Survey data collected from 134 manufacturing exporters in China show positive association of EPR practices with the performance outcomes. Using split group analysis, we found performance differences between the high and low manufacturer groups in customer integration for their EPR practices implementation. Particularly, the high customer integration group achieves better market performance	EPR- manufacturers	export-oriented manufacturers	customer integration, supply chain system capabilities in the age of global complexity				

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue 5	issue 6	issue 7
21 Wagner T.P., Toews P., Bouvier R.	Increasing diversion of household hazardous wastes and materials through mandatory retail take-back	2013	Journal of Environmental Management	123		88	97	10.1016/j.jenvman.2013.03.020	<p>whereas the low group integration reap greater financial benefits. Managers need to understand the role of customer integration and the financial and market performance implications of implementing EPR practices to align with their performance goals and to build their supply chain system capabilities in the age of global complexity. © 2013 Elsevier B.V.</p> <p>retail locations as collection user points for subsequent transport by the county to its transfer facility. This shared responsibility program has been highly effective at diverting HHWM from disposal as MSW. Between April 2009 and October 2012 the estimated collection/diversion rates increased dramatically from near zero percent to approximately 36.44% for fluorescent lamps, 21.4% for household batteries, 28.43% for latex paint, and 72.65% for used medical sharps. For household batteries and fluorescent lamps, the convenience of the collection container and the type of store were statistically significant predictors of the number of batteries and lamps collected. © 2013 Elsevier Ltd.</p>	retail locations as collection user points for subsequent transport by the county to its transfer facility	shared responsibility program has been highly effective at diverting HHWM from disposal as MSW				
22 Wagner T.P.	Examining the concept of convenient collection: An application to extended producer responsibility and product stewardship frameworks	2013	Waste Management	33	3	499	507	10.1016/j.wasman.2012.06.015	<p>post-consumer collection efforts under a generic EPRPS system, this paper identifies and examines five categories of convenience – knowledge requirements, proximity to a collection site, opportunity to drop-off materials, the draw of the collection site, and the ease of the process and the various factors of convenience within each of these categories. By using a simplified multiple criteria decision analysis, this paper proposes a performance matrix of criteria of convenience. Stakeholders can use this matrix to assist in the design, assessment, and/or implementation of a convenient post-</p>	EPRPS frameworks	key to increasing the amount of waste recovered is to maximize the convenience of the collection system to maximize consumer participation.				

(continued)

Table A2. Continued.

Authors	Title	Year	Source title	Vol	Issue	Art. No.	Page/ start end	DOI	Findings	issue 1	issue 2	issue 3	issue 5	issue 6	issue 7
23Nash J., Bosso C.	Extended Producer Responsibility in the United States: Full Speed Ahead? Nash and Bosso, EPR in the U.S.: Full Speed Ahead?	2013	Journal of Industrial Ecology	17	2	175	185	10.1111/j.1530-9290.2012.00572.x	consumer collection system under an EPR/PS framework. © 2012 Elsevier Ltd. In the two-decade period from 1991 to 2011, U.S. states enacted more than 70 EPR laws. In addition, manufacturers have implemented voluntary programs to collect and recycle products, but those efforts have proven largely ineffective in capturing significant quantities of waste products. With the help of new coalitions of diverse interest groups, recently states have renewed efforts to establish effective EPR programs, enacting 40 laws in the period 2008–2011. Several state initiatives suggest a more promising future for EPR. © 2013 by Yale University.	EPR- manufacturers	effectiveness of EPR on its own in collection of waste	new coalitions of diverse interest groups necessary			

Key themes

Links with circular economy	7	convenience	3	links with CSR	2	size of company	1
targets: recycle, collection	5	systems perspective	3	developing economies	2	international trade policies	1
international partnerships	4	integrated EPR	3	retailers	2	government-industry behaviour	1
supply chain/global networks	4	manufacturers	3	investment implementation management	2	funding mechanism	1
					2	technology	1
						traceability	1
						inventory	1
						risk attitude	1
						harmful materials ban	1
						recycling facilities	1
						value system	1