

1 *Review*

## 2 **Consumer Clothing Behavior and Associated** 3 **Environmental Impact**

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8 **Abstract:** Consumer, as one of the vital stakeholders of fashion supply chain, has a significant role  
9 to play to transition fashion industry into sustainable direction. From purchasing and care practice  
10 to donation and disposal, every step of their decision has impact on the environment. Various  
11 internal and external variables, including culture, custom, value, belief, norm and assumption,  
12 economy, gender, and education etc. influence forming that decision. The result of the decision not  
13 only directly impacts the environment and society, but also consumer culture and future business  
14 opportunity. This study synthesizes a wide spectrum of consumer behavior related to clothing  
15 consumption and associated environmental impact. Building on the synthesis, a holistic discussion  
16 is offered which can provide relevant behavioral guideline to consumers as well as other  
17 stakeholders.

18 **Keywords:** sustainability; consumer behavior; clothing; clothing behavior; environmental  
19 sustainability; fashion; textiles; fashion sustainability; clothing sustainability; textile sustainability  
20

### 21 **1. Introduction**

22 This study utilizes Jacoby's [1] idea in defining consumer behavior related to clothing product as  
23 acquisition (purchasing), maintenance (keeping, using, and maintenance) and disposition of clothes  
24 (everything after primary owner's use), as shown in Fig 1. Although Winakor [2] defines clothing  
25 consumption as acquisition, use, maintenance and discard, using Jacoby's idea helps organizing  
26 various clothing related actions of consumers into different segments.

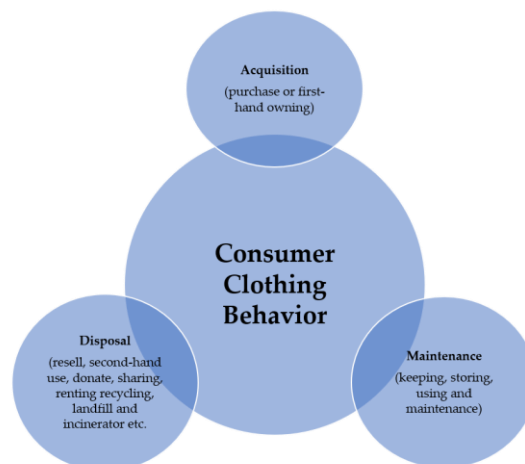


Figure 1 Consumer clothing behavior

27 Sustainable clothing behavior adds extra layer in usual clothing behavior. It refers to putting  
28 social and environmental consideration into acquisition, maintenance and disposal phases of  
29 clothing. Therefore, sustainable clothing behavior of consumer can be understood from three  
30 perspectives: sustainable purchasing, sustainable care and sustainable disposal. This behavior  
31 involves a range of psychological equation guided by one's value, belief, assumption, financial  
32 condition, education, family history, and culture etc. [3]. Consumer awareness and commitment  
33 mainly contribute to sustainable apparel acquisition. Sustainable clothing care is determined by the  
34 number of uses, laundering frequency, washing methods, drying and ironing methods [4]. The  
35 environmental impact from apparel disposal phase can be determined by recycling (upcycling and  
36 downcycling), donation and reuse, throwaway (landfill or incineration), and keeping in the closet  
37 [3,4]. The greatest environmental benefit can be achieved by consuming less and keeping garments  
38 for longer. The other options are reusing (direct or indirect), recycling, energy recovery and  
39 landfilling in order of higher to lower environmental benefit [5]. Landfilling (throwaway) is the  
40 worst of all types of clothing disposal [5]. Sandin and Peters [6] reviewed 41 published literatures to  
41 synthesize findings related to environmental impact of textile reuse and recycling. Laitala [7]  
42 reviewed literatures related to consumer clothing disposal behavior from 1980-2013. However, no  
43 previous study reviewed a wide spectrum of consumer behavior related to clothing and its impact  
44 on the environment. This study offers a comprehensive review of the published literatures dealing  
45 with clothing acquisition, care and disposal and their associated environmental impact. The  
46 following questions guided the researcher during organizing and synthesizing papers:

- 47 I. What is the current norm of clothing acquisition, care and disposal behavior?
- 48 II. What is the sustainable way of clothing acquisition, care and disposal?
- 49 III. What is the impact of usual and sustainable clothing consumption?

## 50 **2. Clothing Acquisition**

51 Mainstream consumers, today, are fast fashion oriented which started around early 2000s [4,8].  
52 Fast fashion is characterized by cheap and low-quality materials. Due to cheap quality materials,  
53 apparel loses its appeal quickly and due to rise in purchase power, consumer can afford buying  
54 new clothes many times a week. By offering new collections swiftly and crafting planned  
55 obsolescence with them, brands allure consumers to refill their wardrobe by throwing away used  
56 clothes that have still their useful life left. Along with them, brands' attractive marketing strategy,  
57 traditional and social media, opinion leaders, bloggers, celebrity, and peers play important role to  
58 influence consumers consume fast fashion [9,10]. As a result, clothing consumption has been  
59 doubled in the last decade whereas consumers keep clothing half as long as they did 15 years ago  
60 [11]. Their usual apparel purchasing decision is mainly driven by fit, color, style, durability and easy  
61 care etc. [7,12]. Mainstream consumers do not care about other side of the clothing (i.e., how it  
62 impacts our environment and society. Most of them have poor understanding of how clothing is  
63 made and the impact of their consumption [13–15]. They have limited knowledge of sustainable care  
64 practice [16]. They also have poor understanding of how their disposal behavior affects the  
65 environment negatively [17]. They do not know where to dispose them and how [18]. Therefore,  
66 educating, measuring and improving sustainability knowledge of consumers should consider all  
67 these aspects of clothing consumption, D'Souza, et al. [19] proposition, and key areas of air, water,  
68 chemical, energy, land etc.

69 Consumer knowledge and awareness of sustainable apparel mainly influence their purchasing  
70 decision. However, it is not true that highly knowledgeable consumer will always buy sustainable  
71 clothing. There exist many other factors that impact the decision. For example, a knowledgeable  
72 consumer might have financial limitation to buy a sustainable piece of apparel (by paying a higher  
73 price) [20]. Moreover, it is difficult for consumers to research and identify sustainable clothing  
74 during their purchasing. They mostly rely on their perception about brands they are purchasing  
75 from and justify their purchase through the lens of reputation of those brands [20]. Harris, Roby and  
76 Dibb [15] mentioned three reasons why consumers fall short of demonstrating sustainable behavior  
77 despite having sustainable clothing option: 1) clothing sustainability is complex and consumers lack  
78 knowledge, 2) Consumers are diverse in their concern and 3) sustainability is less important in  
79 consumer purchase decision criteria.

80 Talking about obstacles, Hiller Connell [14] identified two internal and four external barriers.  
81 Internal barriers include knowledge about eco-conscious apparel acquisition (ECAA) and attitudes  
82 about environmentally preferable apparel (EPA) and external barriers include limited availability of  
83 EPA, economic resource, less-enjoyable second-hand store, and society's expectation. Consumers  
84 have limited knowledge of what materials are more environmentally friendly, how apparel is  
85 manufactured and associated impact on the environment. On the other hand, spending extra money,  
86 putting extra work in acquiring ECAA and less of social acceptance play their part for consumers not  
87 purchasing EPA. Kang and Kim [21] identified and classified perceived risk of consumers that  
88 shape sustainable apparel purchase decision into four main categories: financial, performance,  
89 psychological and social. During forming purchase decision, consumer carefully consider possible  
90 monetary loss, functional deficit, compromise of self-image and social unacceptance.

91 Among the enablers, ethical commitment in apparel purchase and ethical values were  
92 mentioned by Niinimäki [22]. However, product attributes are key to attract consumers to buy EPA  
93 in [14,22]. If EPA cannot compete with fast fashion in terms of attributes and price, the process of  
94 consumer acquisition of EPA would be slow. Creating competitive sustainable fashion having the  
95 same appeal as fast fashion is easier than making consumers aware of the environmental issues and  
96 driving them to act. Six overarching values drive consumers' sustainable apparel acquisition:  
97 self-expression, self-esteem, responsibility, protecting the planet, sense of accomplishment, and  
98 social justice [23]. On the other hand, consumer knowledge of green industry initiatives and green  
99 brands, beliefs relating to corporate responsibility, subjective norms, motivations to research, search  
100 and buy green apparel, and attitudes toward purchasing green apparel were found to influence  
101 purchase intention and purchase behavior of green textiles and apparel [24]. Consumer demography  
102 (i.e., geography, age etc.) has influence on sustainable clothing purchase [25,26]. For instance,  
103 younger consumers show more favorable attitudes towards environmentally responsible clothing  
104 consumption [26]. In addition, subjective norm plays important role in shaping consumer purchase  
105 decision of sustainable apparels [24,27,28].

106 Consumers' belief that they can positively impact environment through their buying of  
107 sustainable apparel (a term called as 'perceived consumer effectiveness') positively impact purchase  
108 intention of sustainable apparel. Similarly, consumers' belief that a particular match their personal  
109 style and value (a term called as 'perceived personal relevance') has positive impact on purchase  
110 intention of sustainable apparel too [28]. The subjective perception of ease or difficulty of engaging

111 in any particular behavior (termed as 'perceived behavior control') has association with sustainable  
 112 apparel purchase [29].

113 However, Hiller Connell and Kozar [30] reported that environmental knowledge did not  
 114 translate into behavior. Likewise, Brosdahl and Carpenter [31] found that knowledge of the  
 115 environmental impact of textile and apparel production did not positively influence  
 116 environmentally friendly consumption behavior. Belleau, Summers, Xu, and Pinel [32] found that  
 117 Generation Y (i.e., millennials) did not feel social pressure to comply with peers or referents in  
 118 forming purchase intention of merchandise made of 'emu leather'. Therefore, it is understandable  
 119 that knowledge, values, beliefs, attitudes, commitment, subjective norm, demographics and external  
 120 factors, as well as different types of internal and external barriers play big role in consumer intention  
 121 and decision making towards acquiring EPA (Figure 2). These variables, when in favorable  
 122 circumstances, can drive consumers to purchase sustainable apparels.

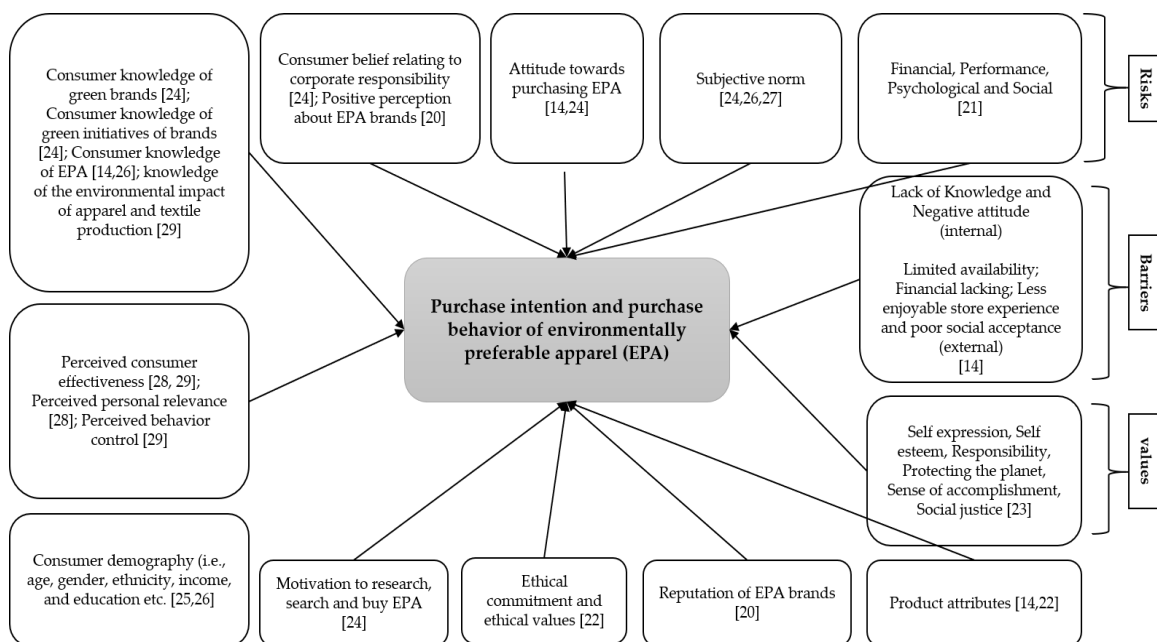


Figure 2 Factors affecting sustainable clothing purchase

### 123 3. Clothing Maintenance

124 Usual clothing maintenance is mainly influenced by everyday habit, custom, social norm  
 125 and culture [20,33]. Most of the consumers do not know the impact of their clothing maintenance  
 126 activities. A very negligible portion of the consumers might know the impact; however, they do not  
 127 necessarily act due to attitude-behavior gap and lack of infrastructure. For example, in most of the  
 128 developing countries, like India and Bangladesh, hand washing, and line drying is prevalent.  
 129 Therefore, the reduced impact from clothing maintenance of those consumers is due to the social  
 130 norm and infrastructure, not due to the awareness. On the other hand, machine washing and drying  
 131 is the social norm in United States and other developed countries. As a result, the environmental  
 132 impact of consumer clothing maintenance is simply result of culture. Since, the western countries are  
 133 on the demand side of clothing supply chain, emphasis should be given in that region to change the  
 134 current norm. Few European countries are promoting line-drying (for example, Denmark, Sweden  
 135 and Germany), yet more efforts are needed to accelerate the move.

136 Clothing care practice in the consumer use phase has massive impact on the environment  
 137 depending on the types of the product. In case of cotton t-shirt, 60% of its life cycle energy  
 138 consumption comes from use phase [16]. A slight modification of consumer behavior in use phase  
 139 might bring significant environmental benefit. For instance, elimination of tumble drying and  
 140 ironing along with washing in low temperature setting, might lead to 50% reduction of global  
 141 climate change impact of clothing product [16]. A lot of other factors determine the environmental  
 142 impact associated with clothing care, for example, types of clothing cared for, lifetime number of

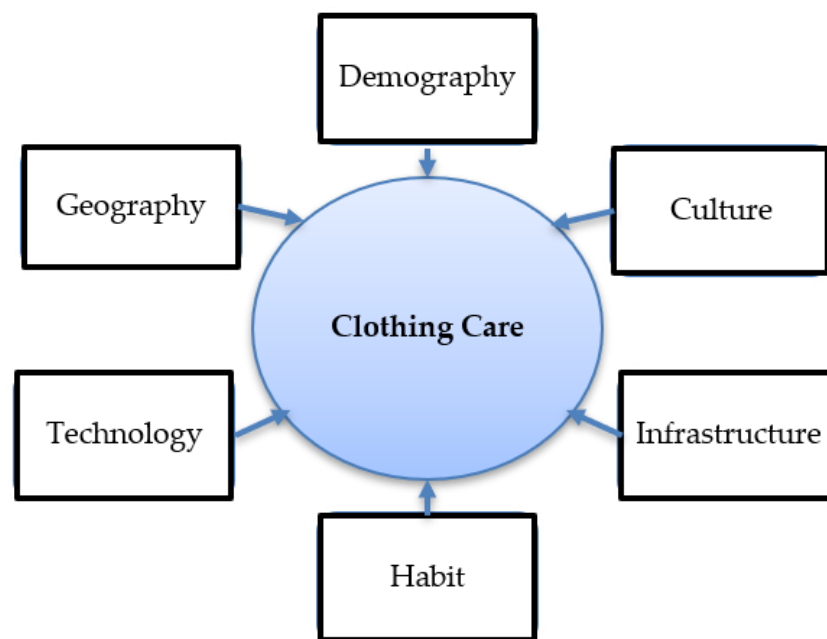


Figure 3 Factor affecting clothing care practice

143 washes, washing machine type (i.e., efficiency, front-loading/top-loading), washing machine setting  
 144 (i.e., cold or hot), geographical location, cultures etc. [16,33,34]. In case of automatic washing  
 145 machine, the environmental impact is determined by the machine type (i.e., horizontal vs vertical  
 146 loading), age of the machine, temperature setting, load size, number of washes etc. Whereas, the  
 147 impact of manual washing is determined primarily by the water and chemicals used. The wash  
 148 cycles vary by the country and size of the household, so do the energy and water consumption.  
 149 Japan was found to carry out the greatest number of wash cycles per households followed by North  
 150 America and Australia [33]. The average water consumption per cycle of washing also varies by the  
 151 type of washing machine used. Vertical axis machine requires twice as much water as that of  
 152 horizontal axis machine per cycle. Water consumption per wash cycle is greatest for north America  
 153 followed by south Korea and Japan [33]. Electricity consumption per wash cycle was found to be  
 154 greatest for Turkey followed by East Europe, West Europe and North America [33]. The annual  
 155 electricity consumption per household for North America from clothing wash was reported as about  
 156 124.3 kWh [33]. This variation in wash cycles, and energy and water consumption suggest that  
 157 different kind of interventions is needed for different geographical locations in order to make  
 158 clothing care habit sustainable. Changing consumer clothing care practice is not easy, rather  
 159 ingrained in multiple layers of knowledge, cultures, habits, customs and geography (Figure 3).

160 Moreover, benchmarking environmental impact from clothing care requires knowing the  
 161 number of times consumer washes different types of apparel. Most of the literatures assumed either

162 25 or 50 wash cycles [16,34,35]. However, in updating the data, Daystar, et al. [4] conducted a survey  
163 of 6,000 respondents from China, Germany, Italy, Japan, the United Kingdom and United States to  
164 characterize the use of T-shirts, knit collared shirts and woven pants. They determined the global  
165 average of total washes per lifetime as 17.3, 22.2 and 23.5 washes for T-shirts, knit collared shirts and  
166 woven pants respectively. Therefore, it seems that assumption of 25 cycles is logical. The average  
167 first-life use period was determined as 37, 40 and 42 months for t-shirts, knit collared shirts and  
168 woven pants respectively. This result suggests greater overall maintenance impact for t-shirt as it  
169 has shorter lifetime. Anyway, diverse types of apparel and more geographical locations need to be  
170 included into future study to upgrade the global average.

#### 171 4. Clothing Disposal

172 Waste generation from throw-away clothes is a big problem which has its root in fast  
173 fashion. The fast fashion is produced in shorter lead time period, typically made with low quality  
174 materials, inexpensive, and built in planned obsolescence [4,8]. Low price of garments, coupled with  
175 increased individual purchasing power, entice consumers to buy a lot of fast fashion, often  
176 impulsively [36]. However, they loss interest of the products quickly because of the low quality and  
177 obsolescence of the fast fashion. As a result, most of these items are thrown away long before their  
178 real usability ends, a phenomenon termed as “throwaway culture” [18].The average American  
179 throws away 82 pounds of clothes every year [37]. In 2015, United States generated about 16 million  
180 tons of textile waste of which 65.7% went into landfill, 19% to incinerator and 15.3% was recycled  
181 [38]. An average UK consumer throws away about 66 pounds of clothing and textiles (total reported  
182 as 2.35 million tons), of which 74% went into landfill, 13% to incinerator and 13% went into material  
183 recovery [16]. The average European Union consumer generates 57 pounds of textile waste [39].

184 Three scenarios might arise during consumer decision making of garment disposition: 1)  
185 keep it (i.e., reuse, downcycling etc.), 2) permanently dispose of it (throwaway, giveaway etc.) and 3)  
186 temporarily dispose of it (loan, rent etc.) [1]. Based on Jacoby’s [1] classification, the factors  
187 impacting the decision of disposing garments can be grouped into three categories: psychological  
188 attributes of the decision maker (personality, attitudes, learning etc.), intrinsic value the product  
189 (condition, fit, durability etc.) and factors extrinsic to the product (finances, fashion change, legal  
190 etc.), shown in Figure 4.. Laitala [7] synthesized published literatures focusing on consumer clothing  
191 disposal behavior from 1980-2013. Those literatures mainly provide knowledge in the following four  
192 categories, as reported in Laitila [7]:

193 I. Destinations: Mainly focuses on where clothes go after disposal. Primary channels identified as  
194 charity, giving away to friends and family, and donation etc.

195 II. Motivations: Focuses on the reasons behind choosing specific disposal methods. Main  
196 motivations identified as convenience of recycling, donating as a form of helping others, and  
197 social and environmental concern etc.

198 III. Disposal reasons: Focuses on why consumers dispose of their garments. As Laitala [7]  
199 synthesized, disposal reasons can be categorized into wear and tear, fit or size, fashion, taste  
200 or boredom and other reasons.

201 IV. Demographics: Focuses on effect of gender difference on clothing disposal behavior.

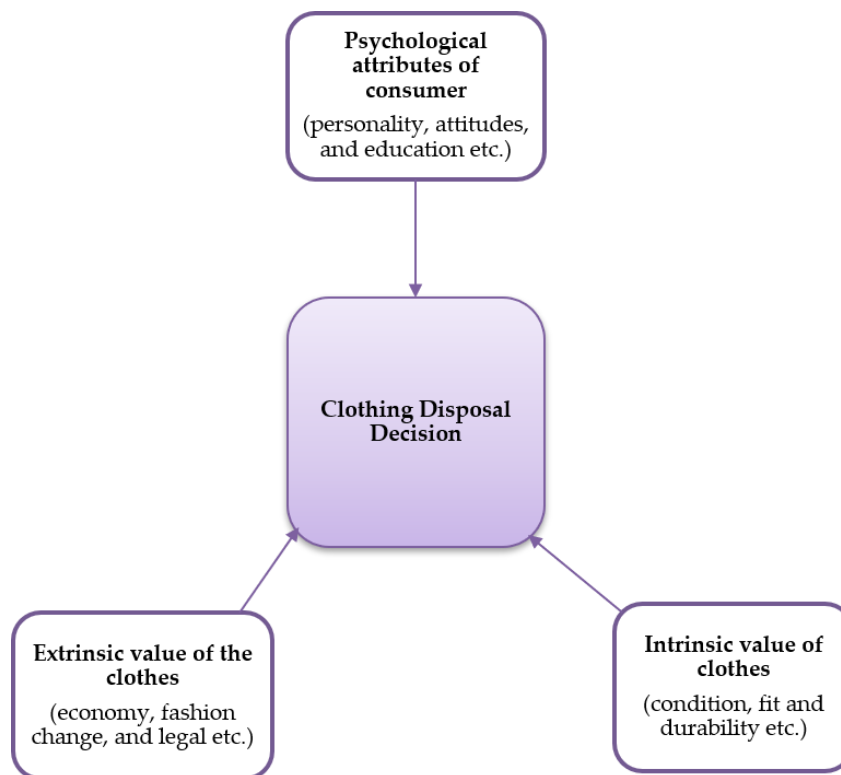


Figure 4 Factors affecting consumer decision of disposing clothes  
(adapted from Jacoby [1])

#### 202 4.1. Clothing Reuse and Recycle

203 Prolonged use of garment has potential to reduce the overall environmental impact of the  
 204 supply chain. Prolonged use can be direct reuse or reuse by others as long as the products have some  
 205 value in it. Prolonged use of garments would reduce the associated manufacturing need and hence  
 206 minimizing environmental impact from the production phase. Allwood, et al. reported, "Extending  
 207 the life of clothing so that demand for new products is reduced by 20% leads to a reduction of about  
 208 20% in all measures in the producing country" [16,p.40]. Other studies also reported the greatest  
 209 energy and CO<sub>2</sub> equivalent savings from direct reuse of the clothing [40,41]. Reducing clothing need  
 210 requiring 1 kg of virgin cotton fibers through using second-hand clothing or reusing might save 65  
 211 kWh. In case of polyester, it might save up to 90 kWh [42]. Farrant, et al. [40] investigated the extent  
 212 to which second-hand clothing reduces the uses of new clothing through a questionnaire survey on  
 213 200 consumers of Denmark, Sweden and Estonia, followed by actual estimation using a quantitative  
 214 method. Utilizing that data in the estimation, the result of their study showed that using 100  
 215 second-hand garments can save between 60 and 85 new garments depending on the place of reuse. It  
 216 also shows that reusing 100 pieces reduces 14% global warming burden from the life cycle of 100%  
 217 cotton t-shirt and 23% of the 65/35 polyester/cotton trouser. This suggests that establishing a reuse  
 218 mechanism of synthetic fibers (i.e., polyester, nylon) is more important than natural fibers. Fisher, et  
 219 al. [41] estimated the environmental benefit of reusing cotton t-shirts and woolen jumpers in UK.  
 220 They reported that direct reusing (e.g., from charity shop and eBay) saves approximately 6.6 lbs.  
 221 CO<sub>2</sub> eq for a cotton t-shirt and 8.8 lbs. for a woolen jumper. Sandin and Peters [6] reviewed the  
 222 published literatures focusing on environmental impact of textile reusing and recycling. Their  
 223 review backed the understanding that reuse and recycling are better choices than incineration and

224 landfill, with reusing be the better option than recycling. However, there are cases where reusing  
225 and recycling might not be environmentally beneficial. For example, if the use of use of recycled  
226 garment does not reduce purchasing of new clothes (i.e., low replacement rate), if the recycling is  
227 powered by fossil energy and if the avoided production as a result of the reuse is environmentally  
228 clean. About half of the published literatures did not consider collecting and sorting stage associated  
229 with reusing and recycling in the estimation of environmental benefit. So, there is a clear gap of  
230 comprehensive understanding of the issue. In addition, the assumption of 'replacement rate'  
231 (garments avoided as a result of reusing) needs to be more studied in order to bring a clear  
232 understating of true environmental benefit from reusing textiles.

#### 233 *4.2. Clothing Donation*

234 Literatures reported both self-oriented reasons and other-oriented reasons behind clothing  
235 donations [43]. Self-oriented reasons are freeing up closet space, being guilt-free etc. [44] and  
236 other-oriented reasons are social and environmental concern, helping others etc. [45,46]. The main  
237 motivation of donating clothes is to free up the closet space [44]. Cloth donation is not primarily  
238 influenced by social consciousness and consumers do not regard donating clothes as valuable as  
239 donating money or food [44]. Consumer keep the expensive and high-quality items as long as they  
240 can. They try to donate those items they do not want to keep them anymore. They throw away those  
241 items even after onetime use, long before their actual useful life [18]. The subjective evaluation of  
242 quality of the garment and sentimental value attached with it play a significant role in deciding what  
243 to donate and what not. If sentimental value is higher, consumers tend to not donate the item  
244 regardless physical condition, for example, an item that reminds a past memory or incident.  
245 Consumers also hesitate donating intimate items, for example underwear [44]. Consumers feel  
246 guilty about how much clothing they own and their limited use of them [44]. Putting in monetary  
247 term, Ellen MacArthur Foundation [47] reported that the industry loss \$500 billion USD each year  
248 due to unutilizaiton of clothes. Close family members and friends are the first choice for clothing  
249 donor [44]. Charity donation is another common method of sustainable clothing disposal [18].  
250 Convenience of donation channel is the important factor determining where the clothes would be  
251 donated [44]. Through the overall act of donation, consumers gain both hedonistic (i.e., good feeling)  
252 and utilitarian value (i.e., freeing up the closet space) from donating clothes [44].

253 On the other hand, consumer who shops for donated clothes from second-hand, thrift store,  
254 vintage shops etc., presumably do so for both self-oriented reasons (to look different, unique etc.)  
255 and other oriented reasons (economy, sustainability, recycling etc.) [48,49]. There exist attitudinal  
256 and contextual barriers in acquiring second-hand apparels [50]. Attitudinal barriers include  
257 consumers' evaluation of second-hand shop as unhygienic, unattractive, less socially desirable etc.  
258 Whereas contextual barriers include unappealing store ambience, unattractive product offerings and  
259 the price mix [50]. Among the motivations, not-wastefulness and economy were found to be  
260 important [51]. Whatever the case, the second-hand clothes need to compete with mainstream fast  
261 fashion products in terms of fulfilling basic attributes of clothes like price, style, fit and attractiveness.  
262 A detail perspectives of clothing donation is given in Figure 5.



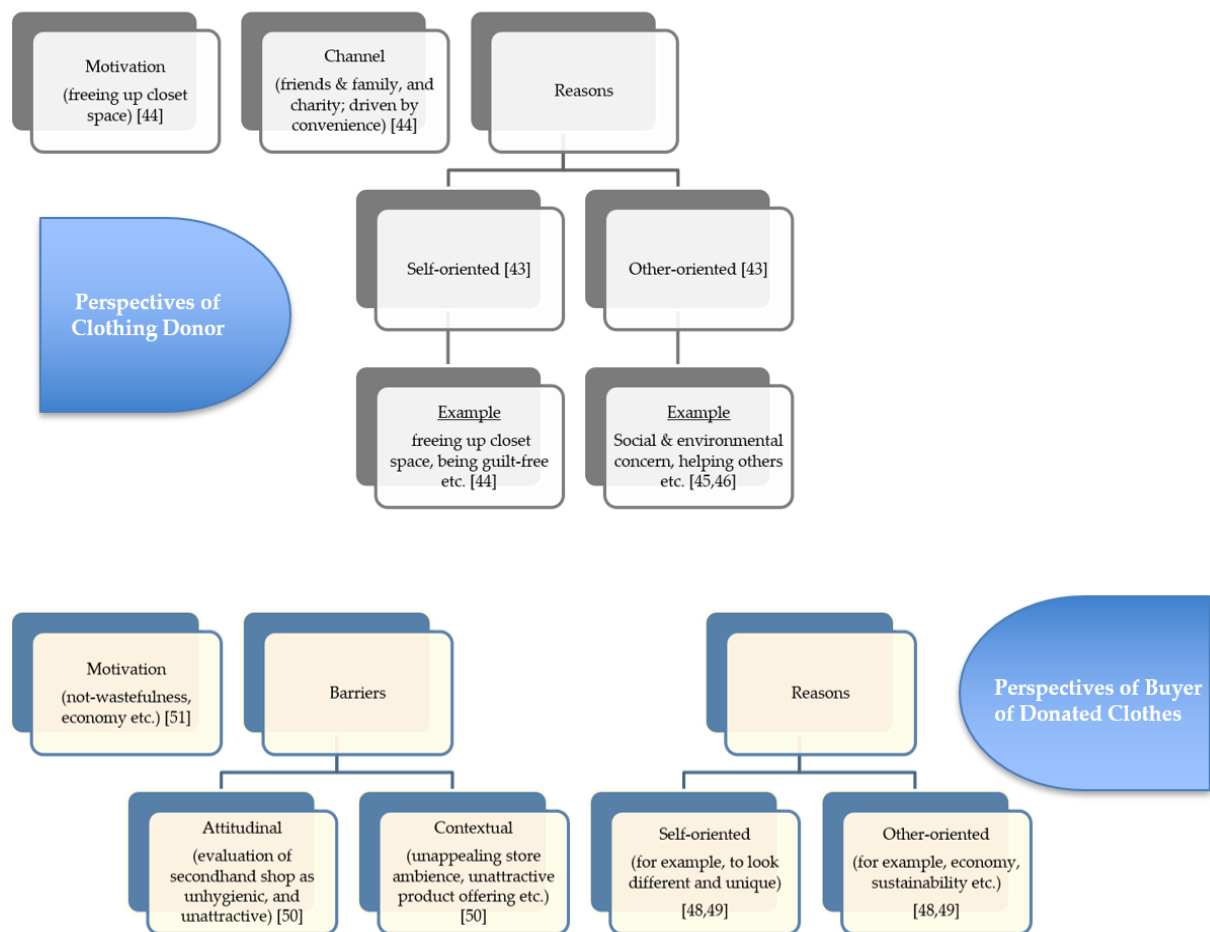


Figure 5 A holistic perspectives of clothing donation

263 Donation is important to extend product life. Extending product life potentially save virgin  
 264 materials and reduce waste. Binning apparels that still have their useful life remaining is a waste of  
 265 valuable resources. Use of 100 pieces of second-hand clothes can save between 60-85 new clothes [40].  
 266 As mentioned earlier, reusing 100 pieces can reduce 14% of global warming burden in case of 100%  
 267 cotton t-shirt and 23% for 65/35 Polyester/Cotton shirt [40]. Donation also diverts clothing from  
 268 going to landfill. If replacement rate of reused clothing is 50% for a certain geographical location, it  
 269 means a reduction of 50% clothing waste load from landfill/incinerator. In case of United States, it  
 270 might divert 10 million ton from landfill, 3 million from incinerator, assuming those clothes were  
 271 still in their useful life [38]. Considering global scale of textile waste, the number would still be  
 272 significant if 10% of all textile waste were still in usable condition.

#### 273 4.3. Clothing Landfill and Incineration

274 The ultimate textile and clothing waste that cannot be used anymore are sent to either landfill or  
 275 incinerator. The incineration with energy recovery is proved to be the better option than landfill.  
 276 Incinerator generates thermal energy which is used to produce electricity whereas landfill generates  
 277 energy in the form of methane gas which can be converted into electricity later. Assamoi and  
 278 Lawryshyn [52] conducted a Life Cycle Assessment (LCA) study of incineration vs landfill. The data  
 279 was collected from the city of Toronto, Canada and used in two scenarios. Scenario one considered  
 280 the entire waste going to the landfill and scenario two considered 50% going to landfill and 50%

281 going to incinerator. The result showed that while landfilling is financially favorable in the short  
282 term, incineration is environmentally beneficial in the long run. The incineration facility produces  
283 more electricity than landfill, reducing dependency on fossil fuel.

284 The main problems associated with incineration are greenhouse gas emission and ash  
285 generation. On the other hand, the main problems associated with landfilling are land use,  
286 groundwater pollution, leachate generations, greenhouse gas emission. Therefore, if textile and  
287 clothing wastes are sent to incinerator with heat recovery, it reduces the need for land use. On the  
288 other hand, incineration has issues with emission and ash. Therefore, those environmental cost also  
289 needs to be considered in calculating true savings from landfill or incinerator.

290 The generated thermal energy from incineration of textile and clothing waste reduces the need  
291 of using fossil fuel. If the incineration happens in and near the facility that generates textile and  
292 clothing waste, it further reduces the environmental burden from transportation activities otherwise  
293 required to send the waste to landfill. Nunes, et al. [53] conducted a study where they characterized  
294 the textile waste (i.e., briquettes) and compared the energy potential and economic benefit of textile  
295 waste over fuel-oil, wood chips and wood pallets. The reported the calorific value of textile waste as  
296 16.8 MJ/Kg, which is very close to the one (i.e., 16 MJ/Kg) reported in Ryu, et al. [54] study. Their  
297 findings showed that using textile waste as a means of thermal energy in boiler reduced fuel cost  
298 80%, 75%, and 70% in comparison with fuel-oil, wood pallets and wood chips. The pay-back period  
299 is 0.7 years, lower than 1.25 years and 1.08 years for wood pallets and wood chips respectively. This  
300 result suggests a clear environmental benefit of using textile waste as thermal energy in boiler. The  
301 benefit primarily comes from reduced use of fossil fuel, transportation need to send the waste to  
302 landfill and greenhouse gas emission reduction from landfill.

## 303 5. Discussion and Conclusion

304 Extending clothing lifetime is important as it reduces the need for buying new clothes. Clothing  
305 lifetime can be either functional or perceptual. Consumer showed different lifetime value for  
306 clothing based on functional durability and perceptual durability [4]. Therefore, it is not sufficient  
307 to use only durable materials to extend the clothing lifetime, rather incorporating emotional element  
308 into the product is important [55].

309 If garment loss its appeal to the primary consumer but still has its useful life, it should be  
310 channeled to reuse (donate, swap, garage sell etc.) by others. Giving away with needy family and  
311 friends is better option than putting garments into donation and recycling bin. The less the clothes  
312 travel for the purpose of being reused, the better. For example, collecting garments from US  
313 households and then sorting in and selling in USA is better than collecting garments from USA and  
314 sending it to be sorted and sold in some African countries. Poor infrastructure of donating and  
315 reselling channels hinders proper management of used clothes and accelerate garment waste  
316 generation [3]. Therefore, infrastructural development is the key to encourage donation, proper  
317 channeling of donated apparels and reduce waste.

318 If garment cannot be directly reused, it should be recycled (either upcycle or downcycle). Using  
319 recycled products might reduce the need for buying new clothes. Considering a 1:1 replacement rate,  
320 using recycled products have significant positive impact on the environment under favorable  
321 condition.

322 If garment does not have any appeal at all, both functional and appearance, it should be sent to  
 323 incinerator for capturing energy. The energy recovery incinerator has environmental benefit over  
 324 landfill. On the other hand, for a wet processing mill (i.e., dyeing) which produces textile waste (i.e.,  
 325 briquettes) in the facility, it should use those textile waste as a fuel in its boiler. If that is not possible,  
 326 the waste should be sent to incinerator. The end of life hierarchy of clothing from sustainability  
 327 viewpoint is shown in Figure 6.

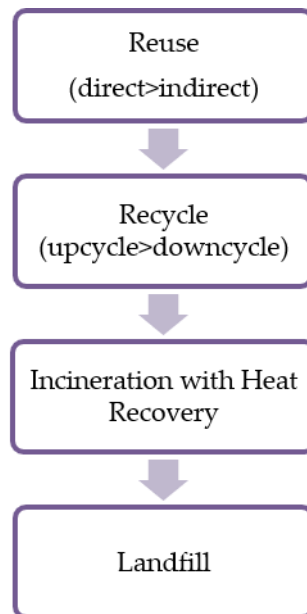


Figure 6 End of life hierarchy of clothing from sustainability viewpoint [5,6]

328 During care phase, consumers should wash less, utilize full load of machine, use cold  
 329 temperature setting (30° C or less), select right detergents (i.e., liquid detergent), use softener (to  
 330 reduce friction and fiber breakage), reduce spin speed, empty residual lint into bin (not in sink) and  
 331 finally air dry clothes [33,56]. Extending clothing life is important to minimize environmental impact.  
 332 Some consumers show unique use-phase behavior associated with jeans. They avoid washing their  
 333 jeans in order to create a fade aesthetic [57]. This kind of products requiring less maintenance need to  
 334 be encouraged. Self-cleaning or superhydrophobic textile fiber can be another alternative too.

335 It is very difficult to change consumer habits of washing clothes unless they realize a real impact  
 336 of their behavior (for example, electricity bill goes up significantly or they need to pay for the water  
 337 they use). If consumer understands the difference of their clothing care practice in terms of money,  
 338 labor and time, they might change their behavior. So, consumers need to be educated of the benefit  
 339 of the sustainable care practice [20]. Improved technology can offer options to reduce the  
 340 environmental impact from washing and drying, but it would always be on consumer hand to  
 341 choose those technologies and their useful options. Therefore, consumers are considered to be the  
 342 key in reducing the environmental impact from care phase [58].

343 Consumer knowledge of the impact of clothing is considered 'the best hope for  
 344 sustainability' in TA industry [59, p A454]. Therefore, they need to be educated of how to acquire,  
 345 care and dispose clothing sustainably. Alternatively, a brand-focused mindset of consumer might

346 help them to deal with lack of knowledge [20]. For instance, if brands are held liable to produce  
347 apparels sustainably, consumers can easily follow any brand without dealing with complex  
348 knowledge of sustainability. This approach seems easier than changing habits and norms of  
349 consumers because brands and retailers operate within certain policy frameworks. Egels-Zanden  
350 and Hanson [60] found that improved transparency of company has positive impact on consumer  
351 willingness to buy product from that company. Nevertheless, a sector-wise ethics and sustainability  
352 guideline needs to be set up from legislating body as individual initiative from any brand might put  
353 itself in disadvantage [20].

354 Sustainable disposal is mainly influenced by knowledge, habits and infrastructure. As usual,  
355 knowledge does not ensure a reflection in the disposal behavior [46]. Habits and routines of  
356 consumers influence disposal behavior more than their knowledge [20]. Clothing disposal is mainly  
357 motivated by convenience and saving money [46]. Therefore, infrastructural change is needed in  
358 order to offer convenience and monetary saving to consumer. For instance, Harris, et al.  
359 [15] suggested monthly doorstep textile collection as an option.

360 Among all three aspects of sustainable clothing behavior, it seems that it would be easier to  
361 bring a change in sustainable clothing care behavior than purchasing and disposal [20]. However,  
362 barriers towards sustainable clothing are ingrained in individual level, social and cultural level and  
363 industry level [15]. Therefore, it is not possible to bring change overnight. It would take  
364 interventions in all three level and obviously it would be a slow process.

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