Towards More Sustainability in Clothing Production and Consumption: Options, Opportunities, and Constraints

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1. Introduction

A large share of the world population still does not have the means to meet even their basic needs. On the other hand, more and more people are living in relative prosperity and their demands for energy and all kinds of goods are increasing (Kharas 2017; Lange and Meier 2009). From a social point of view, the latter development is welcome, but under the prevailing production conditions it implies increasing demand for already limited natural resources. The new emerging middle classes are not primarily responsible for the hitherto existing overutilization of natural resources and ecological capacities. The main responsibility for this lay, until now, with the people living in economically well-developed countries and their consumption attitudes and behaviors—which have unfortunately served as models for people in many emerging countries (Lange and Meier 2009; O'Neill et al. 2018; Simms et al. 2009). Equitable ways must be found to meet individual needs and desires within the ecological limits of the planet. More efficient production methods and better consistency in terms of natural processes are indispensable. However, this will not suffice. Consumption patterns must also be made more sustainable. This is the message of Sustainable Development Goal 12.

More sustainable methods of production and more sustainable consumption patterns are required for every field of supply. In this chapter, the focus is on clothing. On the production side, the field of clothing is characterized by globalized value-added chains, manufacturing sites mainly in least developed and threshold countries, inputs of large quantities of different materials and toxic and eco-toxic emissions (Chapagain et al. 2006; Ellen MacArthur Foundation 2017; Global Fashion Agenda and The Boston Consulting Group 2017; Mekonnen and Hoekstra 2010; Mukherjee 2015; Muthu 2017; Prentice and De Neve 2017). On the consumption side, it must be recognized that clothing is a basic need. Clothes protect the body from thermal, mechanical, biological, and other adverse impacts. Generally, a few pieces of clothing would be enough to obtain these protective functions. However, clothing is more than a protective cover. Clothing is a cultural good, a social differentiation

and communication medium, a sign of social status, and, last but not least, a means to adorn oneself (Simmel 1995; Bourdieu 1992; Esposito 2014). These secondary functions of clothing constitute powerful fulcra for fashion marketing; and fashion marketing is very successful in using it.

Ever faster successions of fashion trends and collections strongly contribute to a steady increase of the demand for garments especially in the economically well-developed and emerging countries. This 'fast fashion' is only possible at the costs of the workers in the textile industry and the environment especially in the producing countries (Chapagain et al. 2006; Mekonnen and Hoekstra 2010; Mukherjee 2015; Muthu 2017; Prentice and De Neve 2017). The clothing production chains, and the clothing market are global. As the vocational skill requirements are low for many jobs in the textile industry, it is easy to take advantage of differences as regards wages, safety regulations, and workers' rights in different countries and to shift clothing production to the countries with the lowest manufacturing costs. Low environmental standards and a lack of environmental surveillance also help to keep production costs low.

Press reports about disasters in clothing factories, like the 2013 Rana Plaza garment factory collapse, when at least 1132 people were killed and more than 2500 injured, and pictures of rivers flowing through textile industrial areas, whose water show the 'it' color of the season, bring awareness of the serious social and ecological deficits along the textile chain to the public. However, the customers dismay does not last long, and the reactions of the global players in the clothing industry are fleeting. In the last years, more sustainably produced clothes have come onto the market, but their share is still marginal.

Are there chances to (a) lower the clothing consumption level and (b) substantially increase the demand for and the offer of more sustainably produced clothing? If so, what can be done to improve sustainability in the clothing market? These are the central questions of this chapter. After a short summary of the economic importance of the clothing sector in the global perspective, and the social and ecological problems associated with the production of clothes, the results of some recent empirical studies on drivers of clothing consumption and the social acceptability of more sustainable consumption alternatives are presented. Then, we give an outlook on possibilities to improve sustainability in the clothing sector, together with experts' ratings of the probability that these will be implemented by 2030.

2. Economic, Social, and Ecologic Aspects of Clothing Production and Consumption

Section 2.1 gives information on the development of the global clothing market and the countries with the greatest market shares. The social impacts of clothing production and consumption are discussed in Section 2.2, and the environmental effects in Section 2.3.

2.1. Clothing Market and Clothing Consumption

The demand for many consumer goods like clothing and mobile phones is increasing much faster than the world population or demands for food and energy (Figure 1). There are two strong drivers for the disproportionately high increase in the demand for clothing

- The fast fashion industry ejects new fashion collections in shorter and shorter time intervals.
- The middle classes with incomes well above subsistence level are growing in threshold and even in less developed countries.
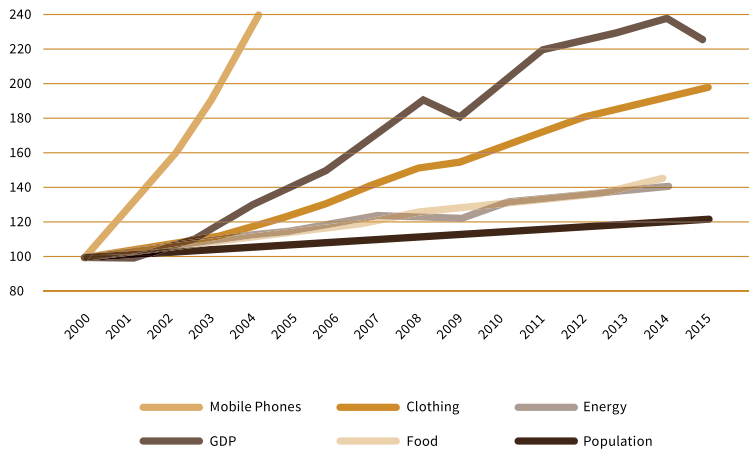

Figure 1. Development of the global population, the gross domestic product, and the consumption of clothing, mobile phones, food, and energy relative to the year 2000 (=100) (data: Ellen MacArthur Foundation 2017; International Telecommunication Union 2018; UN DESA (United Nations, Department of Economic and Social Affairs, Population Division); World Bank 2018). Source: Own illustration.

A projection for 2025 shows percentage increases of per capita expenditures for clothing in threshold countries like Brazil, China, and India that are much higher than those in the developed market countries and regions (Figure 2). However, the consumption level is and will, in the years to come, continue to be much higher in the USA, Japan, and the European Union than in the rest of the world. For the latter, one must bear in mind that there exist large differences between the European countries with respect to clothing consumption: In Luxembourg and Austria, the annual average per capita expenditures for clothing and footwear added up to 1395 and 1025 EUR respectively in 2018 (Eurostat 2020a); in Bulgaria and Hungary, the two countries with the lowest expenditures on clothing, these only reached 123 and 180 EUR respectively. The expenditures for clothing directly reproduce the economic situation in these countries. In Luxembourg and Austria, the gross domestic products per capita come to about 100,000 and 44,000 EUR, in Bulgaria and Hungary only to 8000 and 14,000 EUR (Eurostat 2020b).
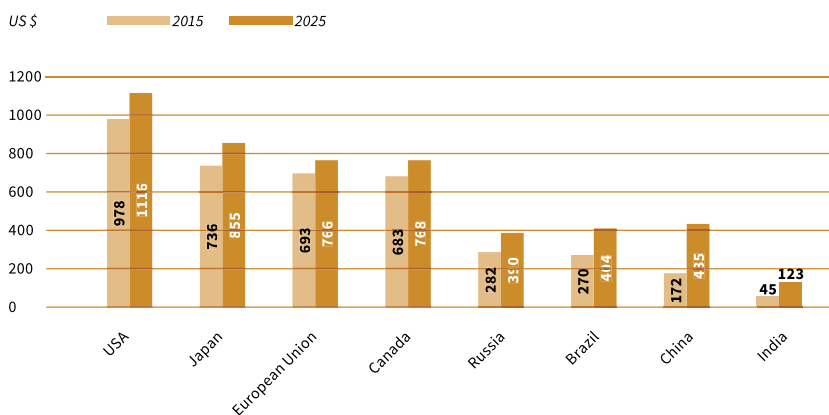

Figure 2. Per capita expenditure on apparel (data: Varun and Kanika 2017). Source: Own illustration.

Since the turn of the millennium the shares of different producing countries in the world clothing market have changed substantially. China increased from 18% in 2000 to 31% in 2018, and Bangladesh and Viet Nam multiplied their percentages (Figure 3). The percent clothing export quota of the European Union remained almost constant. Here, it must be pointed out, that the extra EU (28) exports account for less than one fourth of all EU clothing exports.
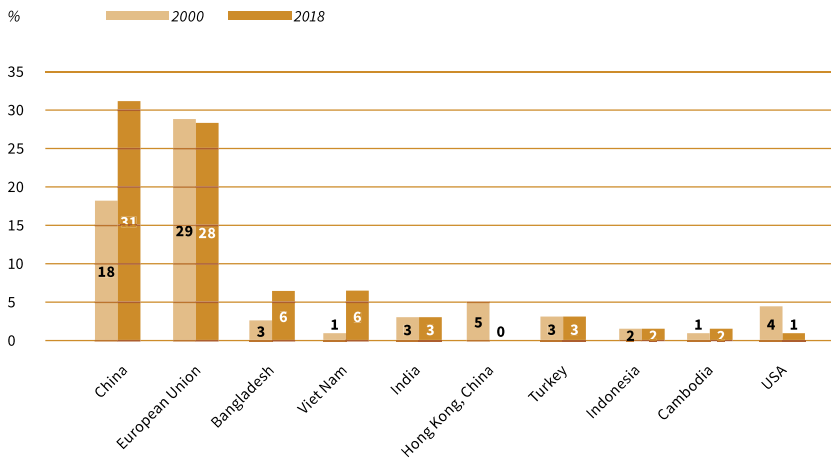
Figure 3. Top 10 exporters of clothing: Percentage of global exports (data: World Trade Organization 2019, rounded). Source: Own illustration.

2.2. Social Impacts of Clothing Production and Consumption

The fashion industry employs over 75 million people worldwide. Most of them work under poor conditions. The social evils elaborated on the following pages are widespread in the clothing industries, especially in Asia and Africa.

2.2.1. Low Wages

In some of the clothing exporting countries in Asia the minimum wages fixed for the clothing industry are even lower than the legal minimum wages (Table 1). In a number of countries, there exist great regional differences, since minimum wages are fixed in reference to the specific regional status of economic development (International Labour Office 2014).

2.2.2. Long Working Times

Some of the biggest clothing production countries have not ratified the Hours of Work (Industry) Convention, 1919 (No. 1), by which a maximum standard working time of 48 h per week and eight hours per day was introduced, with the exception of limited and well-circumscribed cases (International Labour Organization 2014b). In developing clothing producing countries excessive working hours are widespread (ibid.). Due to low wages, workers are compelled to work extremely long hours in order to supplement their basic earnings enough to feed themselves and their families.

Table 1. Textile and clothing industry: Employment, value added, and wages (Countryeconomy 2020; European Parliament 2014; Fibre2Fashion 2019; International Labour Organization 2014a, 2014b; World Bank 2019a, 2019b).

Country	Employment in the Textile Industry: Persons [Million]	Employment in the Textile Industry: Percentage of Total Labor Force	Textiles and Clothes: Percentage of Value Added in Manufacturing	Minimum Wages in the Clothing Industry [USD per month]	Legal Minimum Wages [USD per month]
China	>10	1.3%	10.0%	166–266 [b]	325.60 [c]
Bangladesh	4.0	5.7%	37.6% [a]	68–168 [b]	97.20
Viet Nam	2.2	3.8%	15.4%	90–128 [b]	
India	45.0	8.7%	8.5%	70–106 [b]	54.5
Hong Kong	0.0	0.1%	4.7%	805	821.90
Turkey	0.9	2.7%	17.1%	494	485.90
Indonesia	1.1	0.8%	11.1%	74–219 [b]	137.80
Cambodia	0.5	5.4%	22.3% [a]	100	80.71
Pakistan	15.0	20.0%	28.9% [a]	85–95 [b]	152.70

[a] last available data, possibly outdated; [b] depending on area of production; [c] high variability within the country.

2.2.3. Bad Health and Safety Conditions

The working conditions at many cotton production sites and in many factories along the whole value-added chain of clothing are unacceptable. The workers are exposed to fiber dust, toxic substances, and blasted sand. Many employees work in unsafe buildings without ventilation and emergency exits. Despite some improvements after disasters, like the collapse of the Rana Plaza building in 2013, 'fast fashion' is still putting the health and well-being of garment workers at risk (Prentice and De Neve 2017).

2.2.4. Child Labor

According to the International Labour Organisation 168 million children are engaged in child labor worldwide. This is defined by the UN as "work for which the child is either too young—work done below the required minimum age—or work which, because of its detrimental nature or conditions, is altogether considered unacceptable for children and is prohibited" (International Labour Office 2013). Because the clothing industry predominantly requires low-skilled labor, child labor is particularly common in this industry. Child labor is forbidden by law in most countries, but is still rife in some fiber and clothing producing countries, even those with ratified international conventions against child labor (Table 2). It is

known, that the following countries tolerate child labor in clothing-related industries and agriculture: Argentina, Azerbaijan, Bangladesh, Benin, Brazil, Burkina Faso, Burma, Cambodia, China, India, Kazakhstan, Pakistan, Tajikistan, Thailand, Turkey, Turkmenistan, Viet Nam, and Zambia (Office of Child Labor et al. 2018).

2.2.5. Forced Labor

Two leading clothing producing countries, China and Viet Nam, have not ratified the Abolition of Forced Labour Convention (Table 2) and, as frequent press reports show, forced labor is a problem in these countries. Uzbekistan, one of the world's largest cotton exporters, is another extreme example. At harvest time, the government forces over one million people to leave their regular jobs and pick cotton. Children are taken out of school to harvest cotton. Besides the three countries mentioned, forced labor occurs in one or more stages of the value-added chain of clothing in Argentina, Benin, Brazil, Kazakhstan, Malaysia, Pakistan, Tajikistan, Thailand, and Turkmenistan (Office of Child Labor et al. 2018).

2.2.6. Prohibition of Unions

Over 90% of the workers in the global clothing industry have no possibility to negotiate their wages and working conditions (UK Parliament 2017).

2.3. Environmental Impacts of Clothing Production and Consumption

The production of clothing passes through many stages from the exploitation and preparation of the raw materials and their conversion to fibers, through yarn, grey fabric, and finished fabric preparation to apparel manufacturing. Although, the nature and the degree of the environmental impacts depend on the kind of executed processes, some specific ecological risks can be identified for the different stages of the supply chain (Kleinhückelkotten et al. 2018; Mukherjee 2015; Muthu 2017).

Table 2. Ratfication of ILO conventions (data: International Labour Organization 2020).

	China	Bangladesh	Viet Nam	India	Turkey	Indonesia	Cambodia	Pakistan
ILO Member since	1919	1972	{1950}	1919	1932	1950	1969	1947
Convention, year of adoption								
C029—Forced Labour Convention, 1930	n.r.	1972	2007	1954	1998	1950	1969	1957
C087—Freedom of Association and Protection of the Right to Organise Convention, 1948	n.r.	1972	n.r.	n.r.	1993	1998	1999	1951
C098—Right to Organise and Collective Bargaining Convention, 1949	n.r.	1972	(2019)	n.r.	1952	1957	1999	1952
C100—Equal Remuneration Convention, 1951	1990	1998	1997	1958	1967	1958	1999	2001
C105—Abolition of Forced Labour Convention, 1957	n.r.	1972	n.r.	2000	1961	1999	1999	1960
C111—Discrimination (Employment and Occupation) Convention, 1958	2006	1972	1997	1960	1967	1999	1999	1961
C138—Minimum Age Convention, 1973	1999	n.r.	2003	2017	1998	1999	1999	2006
C182—Worst Forms of Child Labour Convention, 1999	2002	2001	2000	2017	2001	2000	2006	2001

n.r.: not ratified. ( ) ratified yet not enforced. { } Member from 1950 to 1976,1980 to 1985 and since 1992.

2.3.1. Consumption of Material and Energetic Resources

The conventional cultivation of fiber plants requires significant amounts of water. This is especially true for cotton, the most widely used natural fiber in clothing production. On average, the water input to produce one kilogram of cotton fabric is 10,000 L (Mekonnen and Hoekstra 2010, 2011). This represents a severe problem in countries with low water availability and/or insufficient rural water supply infrastructure and management for social, as well as for ecological, reasons. The diversion of water to cotton fields had and has severe impacts on major ecosystems such as the Aral Sea in Central Asia (Chapagain et al. 2006; UNEP 2017).

The other production step with a high water demand is dyeing. Here, the problem is not the 'disappearance' but the contamination of the used water (see below).

The production of clothing requires energy at all stages of the textile chain and, it must be kept in mind, also the frequent transport processes and long transportation routes in globalized supply chains. The necessary energy input strongly depends on

the kind of fiber, and for synthetic fibers is very high. While the production of 1 kg of conventional cotton requires 60 MJ, and that of organic cotton requires 54 MJ, 127 MJ are needed in the case of polyester and 175 MJ in the case of acrylic (Muthu 2014).

2.3.2. Emissions of Greenhouse Gases

As Table 3 shows, fiber and yarn production are the production steps with the greatest shares in the emission of greenhouse gases (GHG) along the production chain of clothes. The data given in Table 3 are derived from the results of a life cycle carbon mapping study (Business for Social Responsibility 2009). In this study, aggregated GHG emissions along the clothing life cycle are reported for different garments of one retailer's assortment. The values in Table 3 are the results of a recalculation omitting the use phase. Table 3 is meant to give an overall picture of aggregated GHG emissions by clothing. However, the actual GHG emissions profile will be different for any given garment.

Table 3. Contribution of the different production steps of clothing to total greenhouse gas emissions (data basis: see text).

Production Step	Contribution to GHG-Emissions [%]
Fiber production	30
Yarn production	26
Preparation and blending	8
Fabric manufacture	11
Dyeing and finishing	5
Other raw materials	8
Garment manufacture (making-up)	3
Packaging	7
Transportation	2

2.3.3. Toxic and Ecotoxic Pollution

The conventional production of plant fibers is associated with extensive inputs of fertilizers and pesticides. About 10% of the entire production of agricultural chemicals are used for cotton production alone (Muthu 2014). Parathion, aldicarb, and methamidophos are among the top ten most widely used insecticides in cotton

production. According to the World Health Organization (WHO) these are extremely hazardous to human health.

A second major cause of toxic and ecotoxic pollution are finishing processes such as singeing, desizing, scouring, souring, bleaching, mercerizing, dyeing, printing, sanforizing, calendering and the application of other special finishes (Muthu 2014). Large quantities of chemicals are used throughout the processes. On average, about 1 kg of chemicals and auxiliaries per kg of finished textile. The remainder reaches the environment mainly through sewage waters, but also through the air.

A problem recognized to its full extent only in recent years are micro-particles from clothes made of synthetic fibers. Micro-fibers are, on the one hand, released during production and use of textiles. On the other hand, they result from the fragmentation of larger items such as discarded clothing (Henry et al. 2019). Since these materials are generally resistant to biodegradation, micro- and nano-plastic particles accumulate in the environment, in terrestrial habits as well as in aquatic and coastal systems. Microplastics have been detected in a wide range of human food and beverages. Up to now, the ecological and human health effects of microplastics are poorly understood, but the evidence for noxious effects is increasing (ibid.).

2.3.4. Waste

When the use of a piece of clothing ends, either because the owner does not appreciate it any longer or because it has reached its material end-of-life, there are several options (Ellen MacArthur Foundation 2017; Global Fashion Agenda and The Boston Consulting Group 2017):

- Reuse;
- Recycling;
- Incineration;
- Disposal to landfill.

Normally, the best option from an environmental point of view is to reuse a garment that is still wearable, potentially after upgrading it. However, in an environmental assessment of secondhand clothes the impacts arising from transportation, collection, sorting, and reselling must be considered.

Recycling to recover the raw materials requires the input of energy and can lead to emissions harmful to health and/ or to the environment. It is, therefore, only the second-best option.

Incineration is not a good option due to the emissions and the problematic waste in the form of ashes. The environmental balance can be improved by recovery

of the energy set free in the combustion process. The worst option is disposal to landfill because landfill space is running low and leachate as well as outgassing are problematic.

Waste also accrues along the production chain and when stocks exceed the demand.

2.3.5. Environmental Impacts in the Use Phase

In the preceding summary the focus was on environmental impacts occurring in the production and after-use phases of clothing. However, in the use phase, substantial amounts of energy, water, and chemicals, e.g., detergents, are applied. Irrespective of the type of textile, the use phase is responsible for up to 80% of the carbon footprint (Muthu 2014).

3. Drivers of Clothing Consumption and Social Acceptability of More Sustainable Alternatives

Whether or not the quantitative volume of clothing production will continue to increase with high growth rates and with negative implications for workers, societies, and the environment depend not least on customers' demands and behaviors. For economic valuations of the market chances of more sustainable clothing alternatives as well as for the design of (social) marketing campaigns to initiate and support more sustainable consumption behaviors, one has to know the drivers of clothing consumption and the motives behind buyers' decisions. These are the subject of this chapter. Selected results from a recent representative survey carried out in Germany (2000 German speaking participants, aged 18 years and above; for the methods and further results see: Kleinhückelkotten and Neitzke 2019a, 2019b) and findings from some similar studies are presented.

3.1. Quantitative Level of Clothing Consumption

Clothing serves not only protective purposes but also fulfills social, cultural, and emotional functions (Simmel 1995; Bourdieu 1992; Esposito 2014). It serves to express its wearers social status (distinction function) and/or individuality. It is used to signal social affiliation or differentiation. It is a means to express emotions and creativity. Figure 4 shows the importance of distinction and individuality in terms of the social attributes gender, age and income. There is a significant difference between women and men as regards the relevance of clothing to express individuality, but no gender difference as to the importance of the distinction function of clothing. The importance of the distinction function of clothing decreases

continuously with increasing age but increases with income. For individuality there is no clear age-related effect and the increase with income is only by trend.

There can be many reasons to buy new clothes:

- The existing clothes are worn out and no longer wearable, or body dimensions have changed.
- Buying new clothes is associated with fun.
- A strong fashion orientation forces the buying of up-to-date clothing.
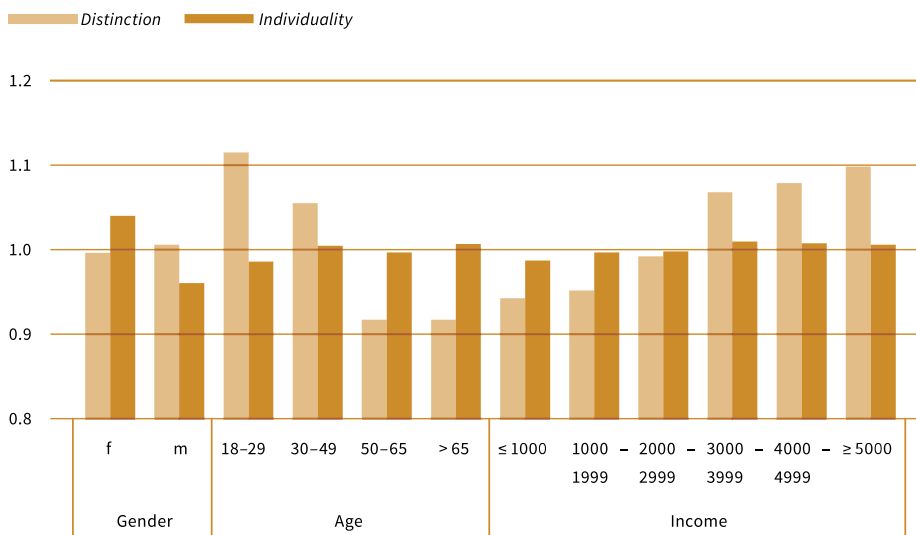- Situational external stimuli, e.g., special offers or other buying incentives, lead to impulse buying.

Figure 4. Social variability of importance of the distinction and individuality functions of clothing (index values, 1.0 corresponds to the population average). Source: Own illustration.

Figure 5 shows that the index for consumption orientation is highest in the youngest population segments, and higher for women than for men. The meta-variable 'consumption orientation' comprises the individual and collective fun of buying new clothes, the impulsive buying of clothes, the frequent buying of clothes without using them afterwards, and the clearing out of the wardrobe to make room for new things. The same population segments also show a high fashion orientation. The meta-variable 'fashion orientation' is an aggregate of several items

representing, among other things, self-evaluation as part of the fashion avant-garde, those knowing what is 'in' and what is 'out', and the statement, that new bought outerwear must match the current fashion trend. Fashion orientation increases steadily with income.

The social patterns of consumption and fashion orientation are reflected in the quantitative level of clothing consumption (Figure 6). The quantitative level of outerwear consumption is calculated from the number of items bought in the last year, and weighted by rough factors for the respective resource input and expenditures in manufacturing. It is higher for women, decreases with age, and increases steeply with income. These results confirm the findings of other studies that income is a strong driver for clothing consumption (e.g., Moser and Kleinhückelkotten 2018; Wahnbaeck et al. 2015). The social differences in the wearing time of clothes, also depicted in Figure 6, are comparatively small.
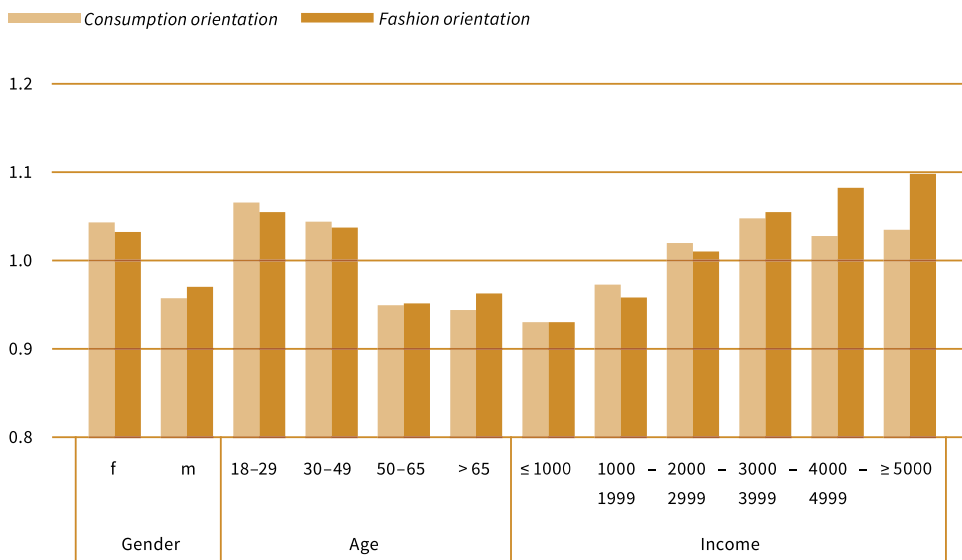

Figure 5. Social variability of consumption and fashion attitudes as regards clothing (index values, 1.0 corresponds to the population average). Source: Own illustration.

Correlation and regression analyses confirm that consumption and fashion orientation are strong, attitude-related, positive drivers for quantitative clothing consumption (Kleinhückelkotten and Neitzke 2019b). Another equally strong consumption stimulating effect is the importance of the clothing function to creativity,

while the effects of distinction and individuality are somewhat weaker. Quality orientation has a weak positive effect; the likewise weak effects of price consciousness and of habitual buying behavior are negative. Consumption and fashion orientation are the strongest negative drivers for a long wearing time of clothes, followed by the factors 'creativity' and 'distinction'. The only significant positive effect, that supports a long wearing time, comes from price consciousness.
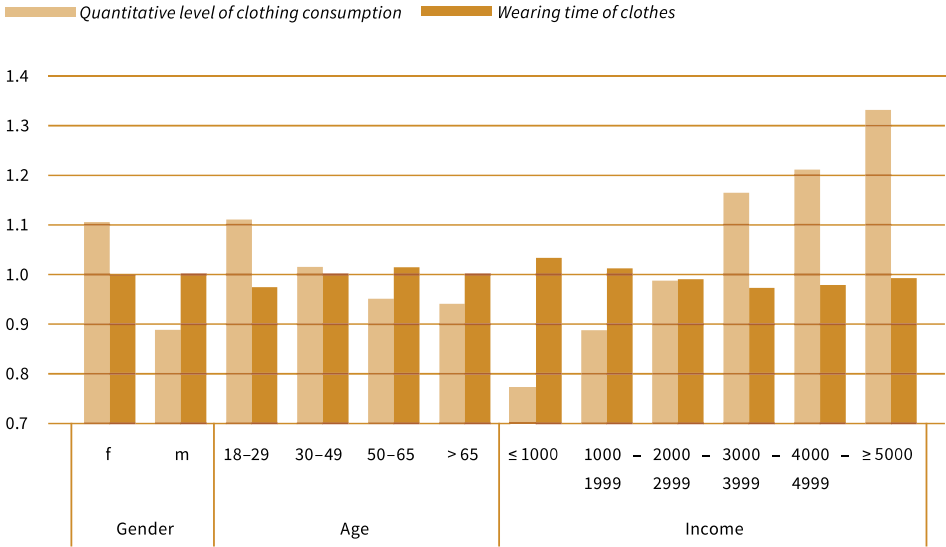

Figure 6. Social variability of the quantitative level of clothing consumption and of the wearing time of clothes (index values, 1.0 corresponds to the population average). Source: Own illustration.

3.2. Demand for More Sustainably Produced Clothing

The awareness of the problems associated with the production and consumption of clothes, as well as general sustainability awareness, has practically no influence either on the quantitative level of clothing consumption or the wearing time of clothes (ibid.). Both attitudes support the buying of more sustainably produced clothing (ibid.).

The problem, as well as the general sustainability awareness, is more pronounced in women compared to men, increases clearly with age, and by trend with income (Figure 7). The frequency of buying more sustainably produced clothing shows similar patterns (Figure 8). Women buy such clothes more often than men, older people

more often than younger, and people with high incomes more often than low-income earners. A more detailed analysis, differentiated according to socio cultural milieu segments, show that more than 70% of people from the critical-creative milieus buy, at least sometimes, clothing produced under environmentally compatible conditions, and even more than 77% state to buy, at least sometimes, clothing produced under socially acceptable conditions (InNaBe 2019). These social milieus are characterized by higher education, a high level of information orientation, and higher-than-average incomes. In the precarious milieus with low incomes and low education levels the corresponding percentages are 35% and 39%. Besides problem and sustainability awareness, quality orientation and the intent to underline one's individuality with appropriate clothes support the buying of more sustainably produced clothing (Kleinhückelkotten and Neitzke 2019b). With regard to promoting the demand for more sustainably produced clothing, it is relevant that the perceived social norm to prefer such clothes has a positive effect on the buying behavior (ibid.). The effect is somewhat stronger for men than for women.

The arguments (or reservations) that prevent people from buying more sustainably produced clothing are

- A too small assortment (stated by 75% of the interviewees: 'I fully agree', 'I agree', 'I rather agree');
- High prices (67%);
- Not fashionable (44%).

To make things worse, nearly 80% of the customers more or less strongly agree with the statement "I do not know, which clothing has been produced in a sustainable manner", and more than 80% state that they feel more or less uncertain whether they can trust the information given as regards production conditions.
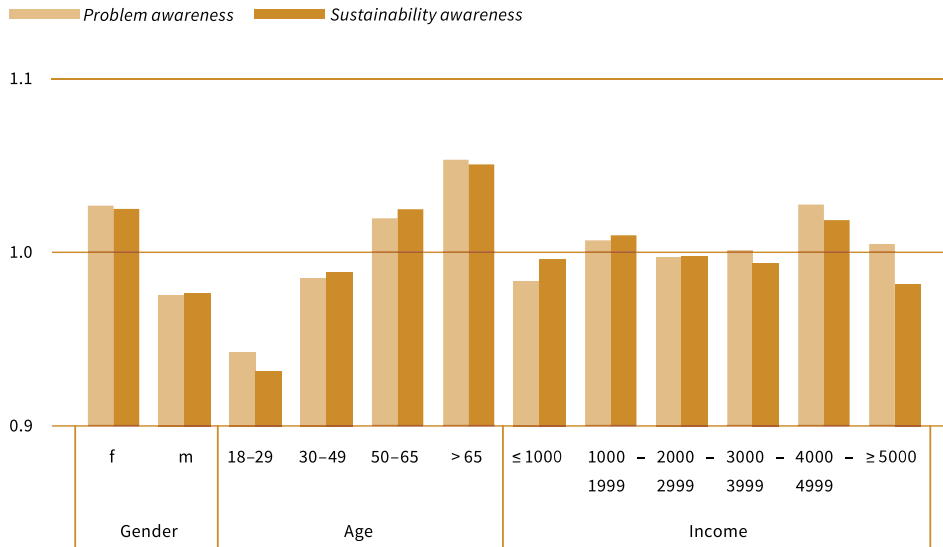
Figure 7. Social variability of problem and general sustainability awareness (index values, 1.0 corresponds to the population average). Source: Own illustration.
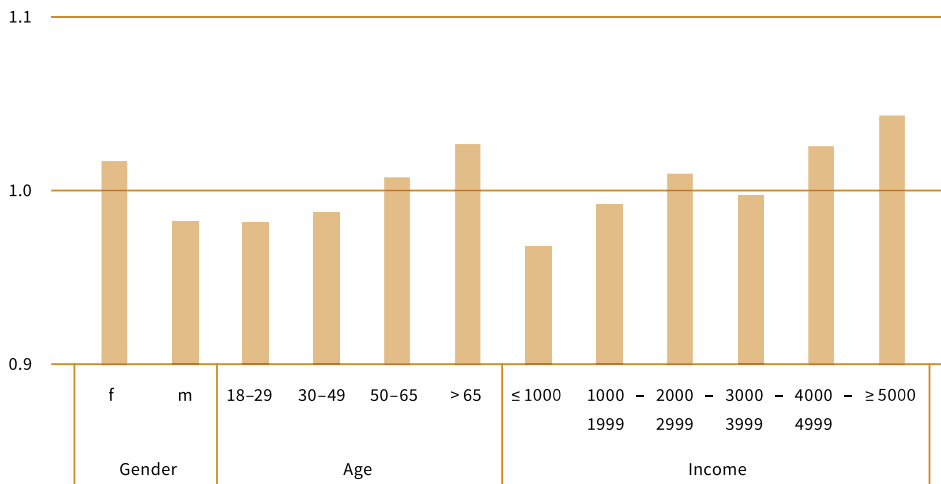

Figure 8. Social variability of the purchase of more sustainably produced clothing (index values, 1.0 corresponds to the population average). Source: Own illustration.

3.3. Second Life of Clothes

There are some alternatives to the buying of newly produced clothes, that could be advantageous from an ecological point of view. They have in common that they allow a second life for sorted out clothing:

- Buying of secondhand clothes;
- Sharing, swapping, lending, renting, or leasing of clothing;
- Repairing of shopworn clothes;
- Makeover of clothing.

The results of the representative survey (Table 4) show that women's openness for the buying of secondhand clothing is greater than that of men. For about 50% of the male interviewees the buying of secondhand clothing is not an acceptable option. The corresponding percentage of the female interviewees is much lower (33.3%). Reservations against secondhand clothes are widespread.

- The assortment of secondhand clothes is too small: 57%.
- The quality of secondhand clothes is not so good: 40%.
- Secondhand clothes are something for needy persons: 39%.
- Secondhand clothes are not fashionable: 36%.

Table 4. Use of second life of clothing options (percent of female (f) and male (m) interviewees who claimed to use the options often or at least sometimes or did not use the options until now but can imagine doing so in the future).

Option	Often		Sometimes		Imaginable	
	f	m	f	m	f	m
Buy secondhand clothing	7.7	2.8	32.7	19.2	24.1	26.3
Swap clothing, internet	2.6	1.3	7.3	7.2	28.5	20.8
Swap clothing, event	2.0	1.6	4.3	6.0	27.4	18.4
Rent clothing for a short time	1.1	1.7	5.0	7.1	34.6	29.5
Rent clothing for a longer time	1.1	1.4	4.0	6.3	20.8	19.0
Have clothing repaired	5.0	3.0	34.9	35.1	27.5	27.5
Have clothing made over	2.6	2.3	19.1	19.5	34.7	32.6

About 42% of the polled women and 55% of the men stated that wearing secondhand clothing would make them feel uncomfortable. The feeling of discomfort is most widespread in the youngest population segment (18 to 29 years: 58%).

Nevertheless, the percentage of those who claimed to buy secondhand clothes often or at least sometimes is higher in the youngest population segment (40%) than in the total population (32%).

In the youngest population segment, we also have the greatest willingness to swap clothes. About 20% of the young do this already and for another about 30% this is at least imaginable. The openness for this option is more widespread among women than among men. For the other options listed in Table 4 the gender differences are only marginal. Regarding upcycling as a possibility to give a second life to clothing that has become out of date it is interesting to note, that the openness for the makeover of clothing is well above 50%.

4. Paths Towards More Sustainability in Clothing Production and Consumption

This section deals with options to improve sustainability in the clothing sector by:

1.   Efforts in the manufacturing industry;
2.   Changes in consumption behavior;
3.   Political and legal frame settings.

Estimates of the developments expected in the next ten years are given based on the results of an expert survey (Kleinhückelkotten et al. 2017). The expert survey was conducted to determine for the time horizon 2030 the probability of sustainability supporting changes in production conditions as well as in consumption trends. Eighty experts from industry, science, and nongovernmental organizations (NGOs) took part in the online survey. They were selected on the basis of a comprehensive actor analysis. The expert survey was complemented by twelve in-depth personal interviews with experts from enterprises, commercial and consumer protection organizations, authorities and five dialogue boards each with around 40 participants. About one half were personally invited due their expertise in the field of clothing production and consumption. It must be kept in mind that the expert survey has been undertaken for Europe, with a partial focus on Germany. Generalizations are limited to countries with similarly developed economies and public debates with respect to global social and environmental responsibilities. However, developments in these countries are of global importance due to the high levels of clothing consumption in these countries and the market power of the major fashion brands residing there.

4.1. Clothing Industry

Important decisions with respect to the achievable degree of sustainability of a piece of clothing are already made in the design phase. Designers should integrate the following objectives into their work:
Long material usability of clothing, e.g., by

- Choosing hard-wearing materials;
- Avoiding potential weaknesses;
- Strengthening especially stressed parts;
- Using adjustable fasteners;
- Ascertaining good reparability.

High appreciation for and modish constancy of clothing, e.g., by

- Varying classical designs in innovative ways;
- Using timeless patterns and colors;
- Making garments multi-use.

Efficient use of material and energy, e.g., by

- Applying zero or minimal waste cuts;
- Allowing for easy disassembly to regain garment parts like hoods, sleeves or lapels for reuse;
- Reusing parts of garments;
- Using materials with good recycling characteristics;
- Ensuring biological circulating capability (cradle-to-cradle).

Environmentally compatible and socially acceptable production of clothing, e.g., by

- Choosing fibers from sustainably cultivated renewable sources.

Little environmental burdens in the use phase of clothing, e.g., by

- Applying soil-resistant and antimicrobial finishes;
- Reducing the energy demand for laundry, e.g., by using fast-drying fabrics;
- Modular design allowing the removal of parts that are easily soiled to wash them separately.

Designers have, at least in principle, a key position when it comes to achieving more sustainability along the textile chain. However, there are two problems: The first is that only a minority of those who create clothing are sensitized for

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and can appraise sustainability issues. There are only a few places around the world, where such issues are integrated in study courses (Educations.com 2020; Masterstudies 2020; The University Network 2018). However, if designers realize and acknowledge their responsibility, they need not be sustainability assessment experts because there are several tools available to help designers optimize their products in terms of sustainability (Colour Connections 2020; Kleinhückelkotten et al. 2018; Sustainable Apparel Coalition 2020a).

The second problem is that designer have a key position regarding product development but their influence on the choice of manufacturing locations, production conditions, and processes is limited (Grose 2017). These decisions are primarily made under economic points of view. They are far too often made on the basis of deficient information. An essential precondition to attain more sustainability in clothing production is the securing of the traceability of garments, including the raw, auxiliary, and working materials along the entire textile chain. This precondition is normally not given in the case of the major fashion vendors. However, there are good examples of smaller fashion labels that ensure full transparency for all stages of clothing production, which is important for their own management decisions and for their marketing. Some market leaders have also recognized the necessity of better information (Sustainable Apparel Coalition 2020b).

Better information and responsible decisions by the major clothing vendors as regards manufacturing sites and processes are needed to ensure that clothing is produced without the application of hazardous substances and production processes, which is important from an environmental point of view as well as for health reasons. We must also guarantee that clothing is produced under socially acceptable conditions, as explained in Section 2.2.

Table 5 lists the developments the experts in our survey expect to occur in the design and manufacturing process of clothing by 2030 (see Kleinhückelkotten et al. 2017). The developments are classified according to their contribution to more sustainability and their probability of occurrence.

According to the experts' ratings, clear improvements can be expected along the total textile chain as well as at particular stages, e.g., a higher degree of transparency along the supply and production chain and an increased input of sustainably produced natural fibers. There are also trends that could run contrary to sustainability, like increased percentages of fabrics made from chemical fibers, fiber blends, and genetically modified plants. The reduction of the potentially negative effects of chemical fibers requires substantial improvements in the production conditions and the recyclability of these fibers. Negative effects in connection with

fiber blends can only be avoided by technical innovations in sorting and recycling. Table 5 also shows that uncertainties exist, as for alternative raw materials and fibers. Synthetic fibers made from cellulose, like viscose or rayon, are presumed to be a more sustainable alternative to cotton, but the environmental compatibility strongly depends on the kind of forest ecosystem management and the fiber production process. Hope is also placed in bio-degradable synthetic fibers, but meaningful environmental assessments are lacking. The environmental effects of new chemical-synthetic fibers optimized for special applications depend strongly on the nature of the materials and the production processes. Appropriate finishes could lower negative environmental effects in the use phase of clothes. On the other hand, additional chemicals could complicate recycling.

4.2. Clothing Consumption

"Buy less, choose well, make it last!" That is the advice given by the design visionary Vivienne Westwood. Customers should take this to heart to contribute to the achievement of SDG 12 in the field of clothing (BBC 2017). From an environmental point of view, the first challenge, namely the reduction of clothing consumption, is the one of greatest importance. "Choose well" means that the buying decision should not be made spontaneously—rather after an objective consideration of the arguments that militate in favor or against the purchase of a piece of clothing. However, it is not easy for customers to make rational decisions. On the one hand, they are hampered by the positive emotions connected with the buying of clothes. On the other hand, the information provided by many vendors is insufficient or misleading. The multitude of eco- and pseudo-eco-labels leads to uncertainty and confusion.

The expert ratings (see Table 5) of some consumption related developments in the period till 2030 are shown in Table 6. The prospects for a reduction of the quantitative level of clothing consumption are dismal. Especially in the young and higher income population segments as well as in the modern mainstream milieus a reduction of clothing consumption cannot be expected. The importance of sustainability issues and the demand for clothing produced under environmentally compatible and socially acceptable conditions will increase. However, the implementation of one standard sustainability label for clothing is not very likely. Increasing demand is also expected for high quality clothing, but this could only have a positive sustainability effect if the clothing is worn for a longer time and supersedes the buying of new items.

4.3. Political and Legal Frame Settings

The dimensions of the environmental and social problems caused by the clothing industry outlined above and the fact that the efforts of the big players in the clothing industry to improve sustainability have been rather tentative so far or even slowed down in the recent past (Lehmann et al. 2019) suggest the conclusion that strict political and legal frame settings are necessary to reach the necessary speeding up of the imperative transformation processes. It is obvious that the clothing producing countries are challenged to ensure humane and environmentally compatible production conditions by their legislation and to control compliance with these regulations. However, they cannot be left alone in solving the problems. As the representative survey showed, most of the consumers, at least in Germany, support stricter regulations by their own authorities. The demand for binding legal provisions is even shared by many companies (Kleinhückelkotten and Neitzke 2019a). There is a broad spectrum of regulatory or incentivizing measures to improve sustainability in clothing production and consumption that can be taken on the part of the countries where the fashion companies are registered and/ or where they sell their products:

- Statutory obligations for executive care;
- Textile regulation with lists of banned chemicals and processes;
- Reporting commitments for all large- and medium sized enterprises;
- Obligation to label the production conditions;
- Reduced VAT and/or custom charges for clothing produced under environmentally compatible and socially acceptable conditions;
- Reduced VAT for repair and upcycling services;
- Obligatory recycling rates;
- Liability of certification bodies;
- Promoting the foundation of companies with innovative sustainability supporting business concepts;
- Funding of sustainability-oriented research in design, textile engineering, textile chemistry, recycling, and sustainability marketing.

Table 5. Developments in the textile industry and their sustainability effects as expected by experts.

Sector Development	Effect
Value-added chain	
Most fashion vendors will disclose their supply relationships and the manufacturing conditions (high transparency of the supply and production chain).	++
The major fashion companies will progressively accept only suppliers that guarantee the observance of high environmental standards and at least the basic ILO working norms.	++
Fashion and design	
The number of annual collections will increase.	-
Some sustainability aspects will be respected in the design process:	
- Seasonal independence;	+
- Multi-use;	+
- Waste avoidance during cutting;	+
- Low energy demand for laundry;	+
- Cradle-to-cradle cyclability;	+
- Reusability of yarn, fibers, and fiber materials;	+
- Repairability;	o
- Reusability of parts;	o
The importance of timeless designs will increase.	+
Raw material and fibers	
The percentages of fabrics made from sustainably produced plant and animal fibers will increase.	++
Solutions will be developed to reduce the abrasion of synthetic fibers (less microplastic).	++
The percentage of cellulose-based (synthetic) fibers will increase.	??
The percentage of fabrics made from bio-degradable synthetic fibers will increase.	??
New chemical-synthetic fibers optimized for special applications will be developed.	??
The percentage of fabrics made from fiber blends will increase.	-
The percentage of fabrics made from chemical fibers will increase.	–
The percentage of fibers from genetically modified plants will increase.	–
Finishing	
Chemicals used in the finishing of clothes will be predominantly unproblematic as regards the environment as well as the health of workers and users.	+
The percentage of clothing with special chemical finishes will increase.	?
Recycling	
The recyclability and usability of chemical–synthetic fibers will improve significantly.	++
New sorting methods will allow for great quantities of the same or similar clothes for upcycling.	+

++ clear improvement expected/high probability for improvement; + slight improvement expected/medium probability for improvement; ?? high probability for development, effect unclear; ? medium probability for development effect, effect unclear; – clear worsening expected/high probability for worsening; - slight worsening expected/medium probability for worsening; o no change expected.

Table 6. Developments in clothing consumption and their sustainability effects as expected by experts.

Sector Development	Effect
Public opinion	
The percentage of customers concerned with sustainability issues will increase.	+
The public pressure on fashion companies to make clothing production more sustainable will increase.	+
Quantitative consumption	
The present trend to buy more pieces of clothing with decreasing price per item will continue.	-
In population segments with higher education there will be an increasing trend towards less clothing consumption.	+
A reduction of clothing consumption in young and higher income segments as well as in the modern mainstream milieus is not very likely.	-
Demand for more sustainable clothing	
The demand for clothing produced under environmentally compatible and socially acceptable conditions will increase.	+
The demand for clothing with ecological or social certification will increase.	+
The willingness of customers to by clothing made from recycled natural fibers will increase.	+
The demand for recyclable clothing will increase.	+
The demand for high quality clothing will increase.	?
The demand for high-price secondhand clothing will increase.	+
Changes in the demand for middle- and low-price secondhand clothing are not very likely.	o
Repair and upcycling of clothes	
There will be no large changes in the demand for repairing and upcycling services.	o
The demand for services to individualize clothing will increase, associated with the positive effect of greater appreciation.	+
Swapping and renting of clothing	
The swapping of clothes	
- via events will increase	+
- via commercial platforms on the internet will increase	+
- via non-profit platforms on the internet will increase	+
Information	
The implementation of one standard sustainability label for clothing is not very likely, either as a state controlled or as a common label of the clothing industry.	-

See Table 5 for the meanings of the signs used in the column 'effect'.

Promising developments are expected by the experts who took part in the survey (see above) regarding the tightening of the ecological, social, and health related requirements to be fulfilled in connection with the production of clothing for Europe (Table 7).

Table 7. Developments in political and legal frame settings and their sustainability effects as expected by experts.

Sector Development	Effect
Regulations of production conditions	
The requirements to be fulfilled in connection with clothing production will be tightened by European regulations as regards:	
- environmental and climate protection;	+
- warranty of employment rights;	+
- health protection;	+
Taxes and customs	
The introduction of reduced taxes for repair and upcycling services is not very likely.	-
A reduced tax for the use of recycled fibers is not very likely.	-
Public procurement	
There will be provisions for a sustainability oriented public procurement.	+

See Table 5 for the meanings of the signs used in the column 'effect'.

5. Conclusions

Most of the steadily increasing mass of clothing is produced and merchandized in globalized production and trade chains. That means that fashion trends and consumption decisions as well as public debates on human rights, climate and environmental protection in clothing importing countries have impacts on the economical state, the working conditions, the level of living of possibly large portions of the population, and the ecological situation in faraway countries. Whether or not the absolutely necessary transformation towards more sustainability in clothing production and consumption will be seriously initiated and will succeed depends largely on the management decisions in the market leading companies, which in turn are strongly influenced by the demand in their key markets. The latter depends on the prevalence of norms and attitudes related to clothing and consumption, but also on the suggestibility of the population by marketing measures.

The results presented in this chapter are based on empirical studies focusing on Germany and the frame settings by the European Union. They are not generalizable on a global scale, but they indicate the options, opportunities, and constraints for a shift towards more sustainability in clothing production and consumption in one of the leading selling markets.

The message is that there is a widespread awareness of the ecological and social problems related with fast fashion, which together with a general, more diffuse sustainability awareness (a) actually stimulates the buying of more sustainably produced clothing and (b) pushes the demand for binding legal regulations that ensure humane working conditions in the textile industry and the observance of environmental standards regardless of the factories' locations.

The bad news on the consumption side is that fashion and consumption orientation are also strong drivers of buying behavior. Generally, they are not opposed to the buying of more sustainably produced clothing, but they impede a reduction of the quantitative level of consumption. Congruously, the polled experts expect the actual trend to buy more pieces of clothing with decreasing price per item will continue, at least in greater population segments. At first sight, one could think that this is good news for the clothing producing countries, because they can count on the preservation of jobs. However, the other side of the coin is the increasing pressure on the manufacturing costs with negative consequences for wages and working conditions as well as for investments in environmental protection measures.

However, some developments with positive effects on the production conditions are on the horizon.

First of all, major fashion companies are on track to improve transparency along the full textile chain. This is a big challenge due to the globalized and highly branched value-added chains. It is an indispensable requirement to meet the expectations of many customers and the stricter statutory provisions pending for the near future.

It can be expected that clothing production will become more environmentally compliant and that the working conditions in the textile industry will be improved—at least as far as clothing produced for the European and comparable markets. Another foreseeable, positive, development is the more consequent consideration of sustainability aspects in the design and product development process. However, it must be pointed out that meaningful sustainability assessments are lacking for many materials, chemicals, and processes that are discussed as potentially more sustainable alternatives.

In summary, it must be stated that though some developments contributing to more sustainability in clothing production and consumption are in sight, the pace of renunciation of unsustainable production methods and consumption patterns is far too low. In view of the dimensions of the problems, it is not adequate to rely primarily or solely on voluntary initiatives by the clothing industry. The states and the international community are challenged to speed up the necessary agricultural and industrial transformation processes by suitable political and legal frame settings.

In parallel, educational institutions, authorities, non-governmental organizations, and other societal actors must intensify their engagement and strengthen social norms and attitudes that abet sustainable consumption behavior in an effort to encourage, support, and consolidate it. This is a Herculean task since nothing short of a cultural shift is required.

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