Ecolabels and Organic Certification for Textile Products

Luis Almeida

Abstract Consumers demand not only specific functionalities and quality levels for textile products but also safety and ecology. In response to this trend, the fashion supply chain places more and more importance on sustainability, forcing textile producers to respect high environmental and social standards in the entire textile-clothing chain, from raw materials to retail. In some cases, the consumer and postconsumer (reuse, recycle, disposal) phases are also considered. To answer the needs of consumers of eco-friendly products, several eco-labeling systems have been developed, which include specific requirements for "organic" textiles. This chapter presents an overview of the requirements of the major eco-labels that are used a, including the European Union Ecolabel (flower label), Oeko-Tex 100 (and the new certification scheme Sustainable Textile Production), Bluesign, organic certification systems (Global Organic Textile Standard and Organic Content Standard), Fairtrade, and labels from retailer chains (Clear to Wear and Ecosafe).

Keywords Textiles · Ecolabel · Organic certification · Sustainability · Health and safety · Social responsibility · Environmental protection

1 Introduction

When purchasing a garment or a home textile, consumers demand not only specific design, functionalities, and quality levels but also safety and ecology, with concern for the protection of the environment and producers in developing countries. Sustainability is becoming more of a marketing tool of the fashion supply chain, forcing textile producers to respect high environmental standards in their production methods (Caniato et al. 2012).

To answer the needs of consumers for eco-friendly products, several eco-labeling systems have been developed, especially since the 1990s (Moore and

L. Almeida (✉)
Department of Textile Engineering, Universidade Do Minho, 4800-058 Guimaraes, Portugal
e-mail: lalmeida@det.uminho.pt

S.S. Muthu (ed.), *Roadmap to Sustainable Textiles and Clothing*,
Textile Science and Clothing Technology, DOI 10.1007/978-981-287-164-0_7

Wentz, 2009). Also within this trend for sustainability, an increased demand for organic products has emerged in the beginning of the 21st century.

Eco-labels in the textile products (either garments or home textiles) are a way to show to the consumer that the products are:

- Safe in terms of human health: this corresponds to the so-called human ecology and is a main requirement for consumers.
- Produced with environmentally friendly materials and technologies: this corresponds to the real ecology, which takes into account the rational use of resources (especially nonrenewable natural resources, water, and energy), air emissions, wastewater, solid waste, use of clean technologies, water and energy recovery, etc.
- Produced with regard to the health and safety of the workers: adequate measures should be used to prevent occupational accidents and protect the health of workers, including the use of collective and personal protective equipment, reducing dust and noise, preventing contact with dangerous and unhealthy chemicals, etc.
- Produced with respect to social criteria in terms of the human rights of workers, namely according to the International Labor Organization standards.

Eco-labeled products must also have certain performance quality levels. The different ecolabel systems impose criteria that affect the entire textile chain, with special emphasis on the dyeing, printing, and finishing processes.

An overview of the requirements of the major ecolabels that are used for textile products is presented in this chapter.

2 European Union Ecolabel

The EU Ecolabel, also called the "flower label" due to its logo, was launched in 1992, according to the Council Regulation (EEC) No 880/92 of 23 March 1992. At that time, apart from private labels, some Member States were launching national labels. The European Commission used this regulation to create conditions for ultimately establishing an effective single environmental label in the European Union. It was also a way to contribute to the consolidation of policies related to the environment, particularly at preventing, reducing, and eliminating as much pollution as possible (prioritizing the source); ensuring sound management of raw material resources; and highlighting the importance of developing a policy towards clean products. The EU Ecolabel system has been fully revised, according to the Regulation (EC) No 66/2010.

The EU Ecolabel identifies products and services that have a reduced impact on the environment throughout their lifecycle, from the extraction of raw material through production, use, and disposal (from cradle to grave) (Hale 1996). It is the only official ecological label within the European Union, as the corresponding regulations have been adopted as EU directives and published in the official journal. It is, of course, a voluntary label, although the competent body in each country is officially appointed by each European Union Member State to be responsible for

collecting the corresponding fees. The fees are normally calculated as a percentage (up to 0.15 %) of the annual sales value of ecolabeled products.

One of the basic principles of this label is to consider the environmental impact during the entire lifecycle of the product. There are several product groups, divided into the following major groups (in alphabetical order): beauty care, cleaning, clothing (including textiles and footwear), coverings (including textile floor coverings), do-it-yourself, electronic equipment, furniture, gardening, holiday accommodation, household appliances, lubricants, other household items (including bed mattresses), and paper products. Other product groups are being developed, in coordination with the European Joint Research Center and with the participation of different interested parties at European and national levels. Criteria are generally revised every 3 years.

Among the different product groups are textiles. The first version for textiles was published in 1995; at that time, it was only applicable to cotton and polyester-cotton T-shirts and bed linens, following a detailed cradle-to-grave study by Danish experts. The last revised version was published in 2009 (Commission Decision 2009/567/EC of 9 July 2009); it was valid until June 2014 and was still under revision at the time of writing. The revised criteria have been published on 13 June 2014 (Decision 2014/350/EU).

The criteria are divided into three main categories: textile fibers, processes and chemicals, and fitness for use.

The applicant must provide detailed information about the textile fibers and all the textile processes, from spinning to fabric finishing. This includes declarations and test reports, as mentioned in the Commission Decision.

(a) Textile fibers

Fiber-specific criteria are set for acrylic, cotton and other natural cellulosic seed fibers, elastane, flax and other bast fibers, greasy wool and other keratin fibers, manmade cellulose fibers, polyamide, polyester, and polypropylene. Other fibers for which no fiber specific criteria are set are also allowed, with the exception of inorganic fibers.

The criteria for a given fiber-type need not be met if that fiber contributes to less than 5 % of the total weight of the textile fibers in the product. Similarly, they need not be met if the fibers are of recycled origin. In this context, recycled fibers are defined as fibers originating only from cuttings from textile and clothing manufacturers or from postconsumer waste (textile or otherwise). Nevertheless, at least 85 % (by weight) of all fibers in the product must be either in compliance with the corresponding fiber-specific criteria, if any, or of recycled origin.

For each fiber, the criteria have been chosen by taking into account the major impacts to the environment.

For cotton, there is a list of restricted pesticides. There are special conditions if the cotton is organically grown. In this case, "organic cotton" can be added to the label if at least 95 % of the cotton is organic. If 70–95 % of the cotton in one product is organic, it may be labeled as "made with X % organic cotton."

For flax, there are restrictions concerning water retting. Wool has restrictions in terms of pesticides and for the treatment of the wool scouring effluent.

For manmade fibers, the ecolabel legislation established specific criteria, either in terms of monomer or polymer production (e.g. emissions to air of acrylonitrile in acrylic fibers) or in terms of toxic substances in the fiber (e.g. adsorbable organohalogens [AOX] in cellulosic fibers or antimony in polyester).

(b) Processes and chemicals

In terms of chemicals, there is an increased concern about Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH) regulation.

There are restrictions concerning the biodegradability of auxiliaries, finishing agents for fibers and yarns, and detergents and softeners.

Chlorine agents are excluded for bleaching yarns, fabrics, and end products.

In terms of dyeing and printing, levels of ionic impurities in dyes and pigments are established. Dyes that are carcinogenic, mutagenic, or toxic to reproduction or potentially sensitizing dyes are banned. Also, azo dyes that can cleave into a list of aromatic amines are banned (according to EU regulations). Chrome mordant dyeing is not allowed, and there are restrictions for metal complex dyes based on copper, chromium, or nickel. Halogenated carriers shall not be used. Printing pastes cannot contain more than 5 % volatile organic compounds. Plastisol-based printing is not allowed.

The word *finishes* covers all physical or chemical treatments for a textile fabric's specific properties. No use is allowed of finishing substances or finishing preparations containing more than 0.1 % by weight of substances that are assigned or may be assigned at the time of application any of the following risk categories (or combinations thereof), as defined by Directive 67/548/EEC:

- R40 (limited evidence of a carcinogenic effect)
- R45 (may cause cancer)
- R46 (may cause heritable genetic damage)
- R49 (may cause cancer by inhalation)
- R50 (very toxic to aquatic organisms)
- R51 (toxic to aquatic organisms)
- R52 (harmful to aquatic organisms)
- R53 (may cause long-term adverse effects in the aquatic environment)
- R60 (may impair fertility)
- R61 (may cause harm to the unborn child)
- R62 (possible risk of impaired fertility)
- R63 (possible risk of harm to the unborn child)
- R68 (possible risk of irreversible effects)

Alternatively, classification may be considered according to Regulation (EC) No 1272/2008 (Classification, Labeling and Packaging (CLP) Regulation). In this case, no substances or preparations may be added to the raw materials that are assigned, or may be assigned at the time of application, with any of the following hazard statements (or combinations thereof): H351, H350, H340, H350i, H400, H410,

H411, H412, H413, H360F, H360D, H361f, H361d H360FD, H361fd, H360Fd, H360Df, or H341.

An applicant to the EU Ecolabel must either provide a declaration that finishes have not been used, or indicate which finishes have been used and provide documentation (e.g. safety data sheets) and/or declarations indicating that those finishes comply with this criterion.

Regarding biocidal or biostatic products, chlorophenols (their salts and esters), Polychlorinated Biphenyl (PCB), and organotin compounds cannot be used during transportation or storage of products and semi-manufactured products.

Only flame retardants that are chemically bound into the polymer fiber or onto the fiber surface (reactive flame retardants) may be used in the product. If the flame retardants used have any of the R-phrases listed above, these reactive flame retardants should, on application, change their chemical nature to no longer warrant classification under any of these R-phrases (less than 0.1 % of the flame retardant on the treated yarn or fabric may remain in the form as before application). Flame retardants that are only physically mixed into the polymer fiber or into a textile coating are excluded (additive flame retardants).

Regarding anti-felting finishes, halogenated substances or preparations shall only be applied to wool slivers and loose scoured wool.

Formaldehyde is traditionally present in crosslinking agents used in textile finishing. The amount of free and partly hydrolysable formaldehyde in the final fabric shall not exceed 20 ppm (or mg/kg) in products for babies and young children under 3 years old, 30 ppm for products that come into direct contact with the skin, and 75 ppm for all other products.

In terms of water and energy use, although there are no restrictions, the applicant shall provide data on water and energy use for the manufacturing sites involved in wet processing.

(c) Fitness for use

Although the EU Ecolabel is not a quality label, minimum quality performance levels are established in terms of dimensional changes during washing and drying, color fastness to perspiration (acid and alkaline), color fastness to rubbing (dry and wet), and color fastness to light.

The following information should appear on the Ecolabel: “encouraging the use of sustainable fibers,” “durable and high quality,” and “hazardous substances restricted.”

The proposed revision of the EU Ecolabel criteria for textiles gives further indications concerning the substances that are used in textile finishing and which may appear on the final product, taking into account the listed hazard classes or risk phrases in accordance with Regulation (EC) No 1272/2008 (the CLP Regulation mentioned previously). The textile hazard class restrictions will be split into textile hazard categories A and B. The following restrictions will in principle apply:

- Substances classified with textile category A hazard classes should not be used in dyeing, printing, and finishing processes and should not be present on the final product.
- Substances classified with textile category B hazard classes should only be used in dyeing, printing, and finishing processes where they have been specifically designated for use and according to associated designated conditions. For these substances, concentration limits must be respected.

In the revision, concentration limits (with respect to the weight of the fiber) for different kinds of finishes will be introduced (e.g. 20 % for flame retardants, 0.3 % for water and stain repellents) and a certain durability of the effect will be required.

New criteria concerning restriction of aerial emissions from finishing processes, namely in terms of organic substances, are also expected in the future.

3 Oeko-Tex 100

Oeko-Tex Standard 100 was developed in 1990 by a group of European research and testing textile institutes, in response to the needs of the general public for textiles that pose no risk to health. The label simply assures that the textile does not contain chemicals that are potentially harmful to the human health (or the so-called human ecology) (Zippel 1999).

The basic elements of the Oeko-Tex® system are as follows:

- Globally uniform and scientifically based (textile and human ecologically relevant) test criteria
- Annual re-evaluation and development of the stipulated limit values and criteria (every year the Oeko-Tex Standard 100 is revised)
- Testing and certification of the textile products through independent test institutes
- Testing of textile raw materials, intermediate, and end products at all stages of processing (modular system)
- Product conformity through internal quality management within the companies
- Company audits to ensure the best possible certification process and targeted support for operational quality assurance
- Product monitoring by means of regular control tests in the market and site inspections by independent auditors from the Oeko-Tex Association

Oeko-Tex tests are based on the three different methods of chemical absorption by the body:

- Cutaneous absorption. Using an artificial sweat solution, the amount of the substance that detaches from the existing fabric due to perspiration is determined.
- Ingestion. Ingestion of harmful chemicals plays an important role, especially in the case of baby items. This aspect is examined with tests using artificial saliva.

- Inhalation of harmful substances. The possibility of inhaling any harmful substances in air is determined by laboratories using olfactometry and emission analysis.

The standard is applicable for all textile and leather products in all levels of production, including nontextile accessories. It is also applicable to mattresses, feathers and downs, foams, upholstery and other materials with similar characteristics. It is not applicable for chemicals, auxiliaries, and dyes, although often the dye and chemical auxiliary manufacturers claim that their products compile with Oeko-Tex 100.

Limit values are established for four different product classes:

1. Products for babies (including children up to 36 months old)
2. Products in direct contact with the skin
3. Products not in direct contact with the skin
4. Decorative materials

Oeko-Tex certification also covers all textile-relevant substances of very high concern on the European Chemical Agency (ECHA) candidate list. The yearly updates of Oeko-Tex Standard 100 take into account the evolution of the list published by ECHA.

The main criteria (according to the 2014 version of the standard) are as follows:

- pH value (4.0–7.5 for classes 1 and 2 and 4.0–9.0 for classes 3 and 4)
- Formaldehyde (not detectable for class 1, up to 75 mg/kg for class 2, and up to 300 mg/kg for classes 3 and 4)
- Extractable heavy metals (restrictions for antimony, arsenic, lead, cadmium, chromium, cobalt, copper, nickel, and mercury; limit values are lower for class 1)
- Heavy metals in digested samples (restrictions for lead and for cadmium)
- Pesticides
- Chlorinated phenols, chlorinated benzenes, and toluenes
- Phthalates (special restrictions for baby articles)
- Organic tin compounds
- Other chemical residues (arylamines, o-phenylphenol, short-chained chlorinated parafines, tris(2-chlorethyl)phosphate, and dymethylfumarate)
- Dyestuffs (cleavable arylamines, carcinogens, allergens, etc.)
- Polycyclic aromatic hydrocarbons
- Biologically active products and flame retardants (not to be used except those in the positive list agreed upon by the Oeko-Tex Association)
- Solvent residues (1-methyl-2-pyrrolidone, N,N-dimethylacetamide, and dimethylformamide)
- Surfactant and wetting agent residues (nonylphenol, octylphenol, nonylphenolethoxylates, and octylphenolethoxylates)
- Perfluorinated compounds (perfluoroctane sulfonates, perfluoroctanic acid, henicosafluoroundecanoic acid, tricosafluorododecanoic acid, pentacosafluorotridecanoic acid, heptacosafluorotetradecanoic acid)

- Color fastness (water, perspiration, dry rubbing, saliva/perspiration)
- Emission of volatiles (formaldehyde, toluene, styrene, vinylcyclohexene, 4-phenylcyclohexene, butadiene, vinylchloride, aromatic hydrocarbons, organic volatiles)
- Determination of odors
- Asbestos is banned.

In addition to the written documents and laboratory testing of the submitted test samples, the certification process involves a company audit at the site of the applicant where the certified items are produced. In general, company visits are carried out every 3 years. A prerequisite for awarding of the certificate is successful evidence of a quality assurance system that guarantees the processing techniques, dyestuffs and auxiliaries, recipes, and material compositions stipulated in the application for certification on an ongoing basis.

Oeko-Tex certificates are issued by one of the participating institutes (there are delegations all over the world) and are valid for 1 year. The association also spot-tests labeled products in the retail market.

Products can be marked with the Oeko-Tex label, providing an effective way of drawing more attention to the products. The association creates its own advertising campaigns. Oeko-Tex 100 is the most widely used textile ecolabel in the market.

4 STeP (Sustainable Textile Production)

The same group of research and testing institutes involved in Oeko-Tex 100 later developed the Oeko-Tex Standard 1000—a testing, auditing, and certification system for environmentally friendly production sites throughout the textile processing chain. To have this certification, at least 30 % of the total production must be certified according to Oeko-Tex Standard 100.

The Oeko-Tex Standard 100 plus is a product label that provides textile highlights to the consumers—not only regarding the human ecology of the products but also environmentally friendly production. It focuses on the effects of transformation processes on humans and the environment, taking into account the hazards of textiles and chemicals on health and well-being, as well as the production ecology. All of the production sites involved in the manufacturing of a specific product need to comply with the requirements of the Oeko-Tex Standard 1000, without exception. This label was discontinued in June 2014. The new certification system STeP (Sustainable Textile Production) has replaced the Oeko-Tex Standard 1000.

The Oeko-Tex Association launched the new STeP system certification system, which offers production facilities the possibility of a modular analysis of all relevant company areas, such as quality management, use of chemicals, environmental protection, environmental management, social responsibility, and health and safety. Because the certification tool is specifically tailored to the situations in the individual processing stages of the textile and clothing industry, it can provide

interested companies with targeted support for continuous improvement of their production conditions. Like the Oeko-Tex Standard 1000, STeP is not itself a product ecolabel.

STeP is a certification system for brands, retail companies, and manufacturers from the textile chain who want to communicate their achievements regarding sustainable production to the public in a transparent, credible, and clear manner. Certification is possible for production facilities of all processing stages from fiber production, spinning mills, weaving mills, and knitting mills to finishing facilities and manufacturers of ready-made textile items. STeP certification involves the permanent implementation of environmentally friendly production processes, optimum health and safety, and socially acceptable working conditions. Like the previous Oeko-Tex Standard 1000, STeP establishes performance levels in terms of the sustainability of production beyond legislative regulations, independently of the country of production.

STeP allows comprehensive analysis and evaluation with regard to sustainable production conditions. In addition to this, the requirements and criteria of STeP certification are specifically adapted to the situation in the textile and clothing industry.

Through modular analysis of all relevant company areas, such as the management of chemicals, environmental protection, environmental management, health and safety, social responsibility, and quality management, the STeP certification allows a comprehensive and reliable analysis of the extent of sustainable management provided by a production facility.

STeP Involves the following issues:

(a) Management of chemicals

- Compliance with the guidelines of a restricted substances list (RSL)
- Introduction of suitable harmful substances management
- Compliance with the principles of 'green chemicals'
- Periodic training and further education regarding the handling of the chemicals used
- Obligation for appropriate communication regarding the chemicals used and their risks
- Monitoring the use of chemicals

(b) Environmental performance

- Compliance with the stipulated limit values
- Use of best available production technologies
- Optimization of production processes
- Efficient use of resources
- Responsible handling of waste, waste water, emissions etc.
- Reduction of the carbon footprint

(c) Environmental management

- Proof of a suitable environmental management system for targeted coordination and systematic implementation of all environmental protection measures
- Commitment to environmental targets
- Periodic creation of environmental reports
- Appointment of an environmental representative
- Periodic training regarding the implementation of environmental targets and measures
- Implementation of existing environmental protection systems (e.g. ISO 14001)

(d) Social Responsibility

- Ensuring socially acceptable working conditions according to United Nations and International Labour Organization conventions
- Execution of performance appraisals for employees
- Implementation of existing social standards (e.g. SA 8000)
- Guaranteed training for employees regarding the social issues of an operation

(e) Quality management

- Implementation of a suitable quality management system (e.g. in line with ISO 9001 or operational approaches)
- Guaranteed traceability, responsibility, and appropriate documentation regarding the flow of goods and manufactured products
- Advanced management aspects, such as risk management or corporate governance

(f) Health and safety

- Proof of suitable measures to ensure the required health and safety in the workplace (e.g. filter systems, ear protection)
- Guaranteed safety of buildings and production plants (e.g. through constructive measures, escape plans, separation of production areas)
- Risk prevention
- Implementation of existing safety standards (e.g. OHSAS 18001).

STeP certification considers three different levels describing the extent to which the company has achieved sustainable production and working conditions:

- Level 1 = Entry level
- Level 2 = Good implementation with further optimization potential
- Level 3 = Exemplary implementation in the sense of a best-practice example

The STeP scoring system is an important tool for continuous improvement.

5 Bluesign

The Bluesign system was also designed to be a solution for a sustainable textile production. It eliminates harmful substances right from the beginning of the manufacturing process and sets and controls standards for an environmentally friendly and safe production. This not only ensures that the final textile product meets very stringent consumer safety requirements worldwide, but it also provides confidence to consumers that they are acquiring a sustainable product.

The idea of the Bluesign system arose from practical experience, in a joint effort from a textile company (Schoeller Textil), a retailer company (Nike), and a chemical company (Huntsman). It was an effort to develop a textile product with the least possible impact on the environment coupled with resource-conserving production and safety for workers and consumers. Bluesign developed from a project initiative in 1997, in order to guarantee that the system is independent and therefore implementable for the greatest possible number of companies. The company Bluesign Technologies AG was founded in 2000, with headquarters in Switzerland.

The label Bluesign claims to be "the independent industry textile standard" because it was developed from the industry and retailers and not by official authorities (like EU Ecolabel) or testing laboratories (like Oeko-Tex 100 or STeP).

Bluesign is based on five principles:

- Resource productivity
  Resource productivity refers to the sustainable use of raw materials and energy. The aim is to produce textiles of maximum quality and added value by minimizing the consumption of resources as well as reducing the environmental impact. Using as few resources as possible during the complete process automatically involves cost efficiency. The environmental impact decreases while the added value of the products increases. Finally, the textile companies reduce their ecological footprint, consisting of energy and material input per kilogram of manufactured textile products.
- Consumer safety
  Consumers are sensitive not only to the safety of the textile products they buy but also to the conditions under which a product has been manufactured. Therefore, consumer safety has to include both the promise of high-quality textile products without health risks, as well as assurance that sustainability was implemented in each step of the production process. Bluesign promotes "proactive manufacturers" that are able to meet the requirements of their customers for sustainable and reliable products—even before legal obligations force them to act.
- Water emission
  Water emission control includes returning purified water into the water cycle and reducing the aquatic environment impact to a minimum. Effective ways include the use of sustainable components, the optimization of production, and the use of wastewater treatment technology. An intelligent selection of process components helps to minimize the amount of harmful substances in wastewater.

As a consequence, the basic contamination of sewage can be reduced. Manufacturers are also requested to install well-functioning wastewater treatment.

- Air emission
  Each process step of textile production causes air emissions. The Bluesign system effects all areas and process steps by directly targeting the basis: the selection of raw materials and chemical products. It specifies strict selection criteria for substances and components having an emission impact. The aim is to reduce CO_2 emissions within the company's sphere of influence as well as during the subsequent process steps. Exhaust air has to be cleaned and recycled by adequate environmental technology. This is the essential condition in order to reduce greenhouse gas emissions and to make an active contribution to climate protection.
- Occupational Health and Safety
  The health and safety of employees in the textile industry have to be safeguarded by strict guidelines. Localized problems have to be detected. Safety measures, according to the risk potential of deployed chemical substances, are mandatory. Occupational health and safety also includes protection against environmental pollution, such as dust and noise.

In fact, the basic principle of the Bluesign system is to eliminate harmful substances from the very beginning, guaranteeing the application of sustainable ingredients in a clean process, at which end stands a safely manufactured product, irrespective of the number of process steps or manufacturers involved. The producers must take into account the positive list of accepted chemical inputs.

Bluesign has a rating system for each applied chemical component based on the criteria described above. Chemicals are categorized as follows:

"Blue" category	components meet all of the Bluesign criteria and requirements.
"Grey" category	components can only be used under certain appropriate conditions.
"Black" category	components do not meet the Bluesign criteria.

Web applications are available, for chemicals, manufacturers, and brands/retailers.

6 Organic Certification

The trend for buying organic products is mainly related to food. Organic certification is a certification process for producers of organic food and other organic agricultural products based on several requirements—the most important of which are related to avoiding synthetic chemical inputs, such as fertilizers, pesticides, antibiotics, and food additives. Genetically modified organisms (GMOs),

irradiation, and the use of sewage sludge are also forbidden. This trend has also emerged in textile fibers.

People from around the world are becoming more and more aware of issues such as global warming, pollution, protection of the environment, and social responsibility. The use of organic fibers, especially organic cotton, is one of the answers to this trend. There is a growing interest in exploring this niche market, which is attracting more and more consumers. Organic cotton is produced in a sustainable way through the management and protection of natural resources, without the use of agricultural chemicals (pesticides and chemical fertilizers) or other products that are harmful to humans, animals, and the environment, while maintaining and restoring the fertility of the soil and assuring biodiversity. It also is softer and less likely to cause allergic skin reactions.

The year 2007 marked a real "boom" in terms of the growth rate of organic cotton: 152 % compared to 2006. Although this rate of increase is now much lower, the fact that 2009 was declared by the United Nations to be the "Year of Natural Fibers" also lead to a large number of initiatives promoting natural fibers, particularly organic cotton.

Conventionally grown cotton consumes more than 10 % of the pesticides used in the world. Organic cotton cultivation is being promoted by several NGOs as a way to have a better environment, higher income for farmers, and better working conditions for laborers (Wakelyn and Chaudhry 2009).

At present, the European Commission is in the final stages of a review of the current EU organic legislation. It has decided that the legal basis of its organic regulation should not be extended to cover textiles (or cosmetics) because the regulation only concerns farming and organic food. Nevertheless, the principles of organic farming can be applied to natural textile fibers, both vegetable (cotton and flax) and animal (wool and silk).

The first European legislation was published in 1992 (Council regulation EEC 2092/91). The present legislation is Regulation EC 834/2007, which is used by certifying bodies for organic certification. Worldwide, the National Organic Program of the US Department of Agriculture is also used.

There are presently many textile consumer products marketed as "organic" (in most of the cases, made with "organic cotton"). Market estimation of organic textiles in the European Union in 2011 was about 1 billion Euro (Matrix Insight Ltd 2012). According to this study, organic is responsible for more than 90 % of this figure, although that represents only approximately 0.7 % of the total cotton world production.

Because the European regulation is not clearly applicable to textiles, there is no official system to avoid misleading claims.

6.1 Global Organic Textile Standard

The major certifying system for organic textiles is the Global Organic Textile Standard (GOTS). This standard was developed following an initiative in 2002. A working group formed in 2004 involves the following four organizations that certify and promote organic textiles:

- International Association Natural Textile Industry, Germany
- Soil Association, England
- Organic Trade Association, USA
- Japan Organic Cotton Association, Japan.

The first edition of GOTS was launched in 2006. The most recent version of GOTS (version 4.0) has been valid since March 2014.

The aim of GOTS is to define globally recognized requirements that ensure the organic status of textiles, from the harvesting of the raw materials, through environmentally and socially responsible manufacturing up to labeling, in order to provide credible assurance to the consumer.

Although this label is based on certified organic fibers, GOTS has very strict demands, not only in terms of the use of cotton fibers (or other natural fibers) produced according to organic agriculture rules, but also for the rules concerning all stages of textile and clothing production, from the fiber to the final product.

If the product is marketed as "organic" or "organic—in conversion," at least 95 % of the fiber content of the products (excluding accessories) must be of certified organic origin or from "in conversion." If the product is marketed as "made with X % organic materials" or "made with X % organic—in conversion materials," then 70 % of the fiber content of the products (excluding accessories) must be of certified organic origin or from "in conversion."

There are several requirements for chemical inputs in all processing stages, banning several inputs, including the following:

- Aromatic and/or halogenated solvents
- Brominated and chlorinated flame retardants
- Chlorinated benzenes
- Chlorophenols (including their salts and esters)
- Complexing agents and surfactants (prohibited are all APs and APEOs (i.e. NP, OP, NPEO, OPEO, APEOs terminated with functional groups, APEO-polymers, EDTA, DTPA, NTA, LAS, α-MES)
- Endocrine disruptors
- Inputs that contain or generate formaldehyde and other short-chain aldehydes
- GMOs and their derivatives (including enzymes derived from GMOs) or made from GMO raw materials (e.g. starch, surfactants, or oils from genetically modified plants)
- Heavy metals (all inputs must be 'heavy metal free,' although certain limits are allowed for impurities)

- Inputs (e.g. azo dyes and pigments) releasing carcinogenic arylamine compounds (MAK III, categories 1–4)
- Inputs containing functional nanoparticles (including all nanofinishes, namely nanosilver, structured nanosurfaces, nano-TiO_2, etc.)
- Inputs with halogen-containing compounds (if they contain >1 % permanent AOX)
- Organotin compounds
- Plasticizers (polycyclic aromatic hydrocarbons, phthalates, bisphenol A, and all other plasticizers with endocrine-disrupting potential)
- Per- and polyfluorinated compounds, such as perfluorinated carboxylic acid (including perfluorooctanoic acid), perfluorooctane sulfonate (including perfluorosulfonic acid) and fluorotelomer alcohol
- Quaternary ammonium compounds (DTDMAC, DSDMAC and DHTDMAC)
- Short-chain chlorinated paraffins (SCCPs, $C_{10–13}$)
- Substances and preparations that are prohibited for application in textiles with a recognized internationally or a nationally valid legal character
- Substances and preparations having restrictions in usage for application in textiles with a recognized internationally or a nationally valid legal character. This concerns substances that are in the list or candidate list of substances of very high concern for authorization (REACH Regulation EC 1907/2006 and further amendments)
- In general, all Inputs that are classified with specific hazard statements (risk phrases) related to a list of health hazards and environmental hazards
- Inputs that are bioaccumulative and not rapidly degradable
- All preparations applied must further comply with requirements concerning oral toxicity, aquatic toxicity, and the relationship of biodegradability/eliminability.

Although all the above inputs are forbidden, certain amounts of residues are accepted (e.g. due to unavoidable contamination).

All chemical inputs intended to be used to process GOTS goods are subject to approval by a GOTS-approved certifier prior to their usage. Preparations must have been evaluated and their trade names registered on approved lists prior to their usage. GOTS issues a positive list of textile auxiliary agents (chemical inputs) containing the trade names of applied preparations that have been found to be compliant with the criteria of this standard.

For all chemical inputs (substances and preparations), a Material Safety Data Sheet (MSDS) prepared according to an applicable recognized norm or directive must be available. All stages through the supply chain (from spinning to retail) must be established so as to ensure that organic and conventional fibers are not commingled and that organic fibers and GOTS goods are not contaminated by contact with prohibited substances.

GOTS has restrictions concerning all textile processes. This includes oils in spinning, weaving and knitting, and sizing agents. The most demanding restrictions concern the wet processing stages. In terms of pretreatment, apart from the use of allowed chemical auxiliaries, only oxygen-based bleaches are allowed and

mercerization is only accepted if alkali baths are recycled. Ammonia treatment and chlorination of wool are prohibited. For dyeing and printing, there are many restrictions on dyes and pigments, as well as printing processes.

For finishing, apart from all the restrictions mentioned above, prohibited in general is the use of synthetic inputs for antimicrobial finishing (including biocides), coating, filling and stiffening, lustering and matting, as well as weighting. Garment finishing methods that are considered to be harmful to the workers (e.g. sandblasting of denim) are prohibited.

GOTS includes specific requirements for additional fiber materials and accessories present in the final product. GOTS also established additional specific requirements for textile personal care products.

Although GOTS does not specifically require that the companies have an environmental management certified system, a written environmental policy is required, as well all procedures and data, especially in terms of wet processing units. Full records must be kept on the use of chemicals, energy, water consumption, and wastewater treatment, including the disposal of sludge. In particular, companies must continuously measure and monitor wastewater temperature, wastewater pH, and sediment quantities. There are specific requirements concerning water discharges (chemical oxygen demand, pH, and temperature). There are also requirements for storage, packaging, and transport, namely in terms of the prevention of contamination and restrictions concerning packaging materials.

One of the main requirements that are taken into account by GOTS auditors are recordkeeping and internal quality assurance. Companies must have effective documented control systems and records that enable the following to be traced:

- The origin, nature, and quantities of organic and additional (raw) materials, accessories, and inputs that have been delivered to the unit, including transaction certificates for organic fibers
- The flow of goods within the unit (processing/manufacturing steps performed, recipes used, and stock quantities)
- The composition of manufactured products
- The nature, quantities, and consignees of GOTS goods that have left the unit
- Any other information that may be required for the purposes of proper inspection of the operation

Records relevant to the inspection must be kept for at least 5 years.
GOTS also includes some technical quality parameters, such as the following:

- Color fastness: rubbing (dry ad wet), perspiration (alkaline and acid), light, washing (in general at 60 °C, at 30 °C for animal fibers) and saliva (for baby and children's clothing)
- Dimensional changes after washing (in general at 60 °C, at 30 °C for animal fibers)

Social criteria are also very important for GOTS. These criteria are nearly as strict as those in the SA 8000 standard. They must be respected in the entire textile supply chain.

In terms of a quality assurance system, processors, manufacturers, and traders of GOTS goods must participate in the GOTS certification procedure, which is based on an on-site annual inspection cycle (including possible additional unannounced inspections based on a risk assessment of the operations). They must hold a valid certificate of compliance listing the certified products/product categories and the processing, manufacturing, and trading activities that are qualified under the scope of certification (including the names of subcontractors assigned and their relevant processing and manufacturing steps).

The companies must perform a risk assessment, and the quantity of residues and technical quality parameters must be tested. The testing frequency, type, and number of samples are to be established according to the risk assessment. Samples for residue testing may also be taken by the inspector during the required on-site inspection, either as a back-up to the inspection process or for suspicion of contamination or noncompliance. Additional samples of goods may be taken from the supply chain at any time without advance notice. Tests must be conducted in laboratories that are accredited according to ISO/IEC 17025 and that have appropriate experience in residue testing for textiles.

GOTS-certifying organizations must be accredited by the GOTS International Working Group, in accordance with the document 'Approval Procedure and Requirements for Certification Bodies.' According to a survey of Portuguese textile companies, GOTS is considered to be the most demanding certification scheme (Almeida and Tristram 2012).

6.2 Organic Content Standard

In 2007, the international organization Organic Exchange (OE) developed the OE 100 and OE Blended standards, to verify the organic cotton content claims on products. The standards established a system for tracking and documenting the purchase, handling, and use of certified organic cotton fiber.

Since then, there has been a need for a broader organic standard that would support content claims for all organic inputs, not just cotton. To meet this need, Textile Exchange (the new name of the Organic Exchange) developed the Organic Content Standard (OCS), based on the generic chain-of-custody requirements of the Content Claim Standard.

The first version of the OCS Standard was published in 2013. OCS applies to any nonfood product containing from 5 to 100 % organic material. It verifies the presence and amount of organic material in a final product. It tracks the flow of a raw material from the source to the final product, and this process is certified by an accredited third party. It allows for transparent, consistent, and comprehensive independent evaluation and verification of organic material content claims on products. It also can be used as a business-to-business tool to give companies the means to ensure that they are getting what they are paying for and selling.

The OCS standard is still mainly used to certify textile consumer products made with organic cotton. Unlike GOTS, the only requirements relate to the organic origin of the material and can be applied to a product containing just 5 % organic material.

7 Fairtrade

Fairtrade is an alternative approach to conventional trade that is based on a partnership between producers and consumers. Fairtrade offers producers a better deal and improved terms of trade. This allows them the opportunity to improve their lives and plan for their future. For consumers, Fairtrade offers a powerful way to reduce poverty through their everyday shopping.

When a product carries the Fairtrade mark, it means that the producers and traders have met Fairtrade standards. The standards are designed to address the imbalance of power in trading relationships, unstable markets, and the injustices of conventional trade.

Fairtrade, unlike other labels mentioned in the previous sections, is not in itself an eco-label, but it is committed to protecting small producers in major markets. Indeed, it helps them escape poverty and improve their living conditions, while transmitting social, environmental, and management knowledge. Fairtrade and organic products are often associated with each other (Bassett 2010).

The Fairtrade minimum price is the minimum price that a buyer of Fairtrade products has to pay to a Producer Organization for their product. It is not a fixed price. It is set at a level to ensure that Producer Organizations receive a price that covers the cost of sustainable production for their product and permits them to develop the social criteria in their organization. However, when the market price is higher than the Fairtrade minimum, the buyer has to pay the market price. Producers and traders can also negotiate a higher price—for instance, depending on quality of products.

Fairtrade publishes a series of standards that are designed to tackle poverty and empower producers in the poorest countries in the world. The standards apply to both producers and traders. There are standards for small producer organizations, hired labor, contract production, and trade standards. One of the standards relates to fiber crops—namely, to cotton seeds.

Fairtrade certified cotton was launched in 2004. At present, some retailers are asking to their suppliers to implement the requirements of Fairtrade, namely by using certified cotton along the textile chain.

Fairtrade has also launched a project that aims to develop a specific textile standard. The Fairtrade Textile Standard will set the requirements for operators at different levels of the textile supply chain processing Fairtrade certified cotton, with the intent of leading to greater worker empowerment, ensuring decent working conditions and wages, improved livelihoods for workers, increased market access for Fairtrade cotton producers, and more sustainable supply chains for all operators. The textile standard will be guided by the Fairtrade Hired Labor Strategy and other

leading social standards and approaches in the textile industry. The target is to publish the standard in 2016.

8 Labels from Retailer Chains

Many retailers have developed their own labels to demonstrate to buyers that textiles are sustainable, but with special emphasis on the safety of the consumers. These labels or certifying schemes impose very strict requirements on the suppliers.

These labels have recently become stricter in terms of product safety, due partly to the action of the nongovernmental environmental organization Greenpeace International. The campaign DETOX (toxic-free fashion), directed to major fashion leader retailers, and a study about the presence of toxic substances in children's clothing induced a reaction in retailers, which was passed on to their suppliers.

8.1 Clear to Wear

Clear to Wear is a product health standard developed by Inditex group, in collaboration with the University of Santiago de Compostela (Spain), in conformity with the most stringent legislation on product health and safety. Clear to Wear is of general application and obligatory for all the clothing products, footwear, accessories, and/or textiles supplied to Inditex.

In addition to composition, pH, and color fastness, this standard regulates "substances whose use is legally limited" that, if present in the product above certain levels, could be hazardous for human health, including Formaldehyde, arylamines, phenols Pentachlorophenol (PCP) and Tetrachlorophenol (TeCP), cadmium, lead, mercury, chromium, chromium (VI), nickel, phthalates, polybrominated flame retardants, pesticides, short chain chlorinated paraffins, perfluorooctane sulfonates, dimethyl fumarate, organotin compounds, and allergenic dyes. Additionally, Clear to Wear sets limits to the use of two parameters not contemplated by the legislation in effect: organochlorinated compounds and isocyanates.

Clear to Wear includes REACH as the EU regulation of mandatory compliance for all Inditex suppliers. This standard is of general and mandatory application for all clothing products, footwear, accessories, and/or fabrics supplied to Inditex.

The supplier is the only party responsible for the compliance of the products supplied to Inditex with Clear to Wear. Regardless of the commitment accepted by the supplier to control the parameters regulated in Clear to Wear, Inditex will verify its correct implementation at any phase of the manufacturing process of those products that are manufactured, commercialized, and/or distributed by it by carrying out routine and random sample analyses on determined models/quality at any point of their production cycle. The corresponding costs are to be supported by the suppliers.

Clear to Wear defines 10 families of products, according to article type, degree of contact with the skin, and age of the end user:

- Products for users younger than 3 years old (babies)
- Clothing in direct and prolonged contact with the skin
- Clothing not directly in contact with the skin
- Parts of footwear in direct and prolonged contact with the skin
- Parts of footwear not directly in contact with the skin
- Accessories in direct and prolonged contact with the skin
- Accessories not directly in contact with the skin
- Metallic-only accessories
- Home textiles in direct and prolonged contact with the skin
- Home textiles not directly in contact with the skin.

For each product family, Clear to Wear defines limit values to be respected. These limit values are similar to those specified by the label Oeko-Tex 100.

The Clear to Wear reference manual published by Inditex presents detailed information for each substance of limited use. This information includes where the substance can be found, the international or different national regulations, the test methods, acceptable or detection limits, and the ways to avoid or limit the presence of the harmful substance.

9 Eco Safe

Eco Safe is a mark of the ICQ group (based in Italy) to be used by companies who believe in adherence to increasingly higher standards of quality and safety. This label is mainly used by the Benetton Group.

The Italian ICQ group, founded in 1982, works at international level as a certification institute for quality and safety of consumer products. The textile division was founded in 1995. ICQ is now part of Underwriter Laboratories, a global independent safety science company with more than a century of expertise innovating safety solutions.

The Eco Safe mark is applied to all products in the children's range (United Colors of Benetton, Undercolors of Benetton, Sisley Young). The presence of the brand Eco Safe mark on the garment indicates that the products have been designed in compliance with chemical and mechanical safety standards, including the following:

- *Small parts* Small parts, such as buttons, zipper pulls, studs and eyelets, present a potential hazard to children if they are not well secured to the garment (choking hazard).
- *Dangerous strings and drawstrings* Often clothes have cords and drawstrings that can have either a functional or a purely decorative purpose. On children's clothing, they can become potentially dangerous, causing serious accidents

(strangulation hazard). Cords and drawstrings are restricted in Europe by the standard EN 14682 (clothing for children up to 14 years old).
- Carcinogenic dyestuffs (damage to health, including carcinogenic effects).
- Allergenic dyestuff (possible sensitization, possible dermatitis, itching, redness of skin).
- Phthalates (possible allergic reactions and/or irritation in case of skin contact, possible harmful effects on the reproductive system, liver or kidney damage or damage to the nervous system). The problems are greater for children, especially younger ones, who have a habit of putting objects in their mouths.
- Formaldehyde (possible allergic reactions and/or irritation in case of skin contact; potentially carcinogenic).
- Heavy metals (possible allergic reactions and/or irritation in case of skin contact, possible nerve damage, possibly carcinogenic).

Benetton's entire network of suppliers is involved in achieving the goal of final consumer safety. Materials, semi-finished products, and production phases are subjected to strict controls and screening through comprehensive statistical sampling.

Benetton and Inditex are just two examples of the efforts made by major retailers and brands to demonstrate to their customers that their products are safe and eco-friendly.

For instance, in 2013, Marks & Spencer reported that significant progress had been made in increasing the amount of sustainable cotton; in fact, the company claimed that nearly 11 % of their cotton products were Fairtrade, recycled, organic, or sourced from the Better Cotton Initiative, compared with 3.8 % in 2011–12.

The Swedish fashion retailer H&M, according to Textile Exchange, leads the list of the biggest users of certified organic cotton in the world. H&M claims that its plans are to source 100 percent of its cotton from "more sustainable" sources by 2020.

The Dutch chain C&A also has a strategy of increasing organic cotton, as a key role for sustainability. In 2013, organic cotton represented 38 % of its total cotton sales. The retailer also publishes an updated list of restricted substances, very similar to the Oeko-Tex 100 limits.

Many other major retailers have also defined their sustainability strategies, which often include commitments related to the restrictions imposed by major ecolabels.

10 Other Labels and Certification Systems

Many other labels can be applied to textile products to demonstrate ecological aspects. In fact, worldwide there are about 450 ecolabels, of which more than 100 can be applied to textiles, according to the Ecolabel Index (see http://www.ecolabelindex.com).

It is not possible to provide a complete review of all these labels here. Nevertheless, it is worth mentioning some of them (in alphabetical order):

Blue Angel, Carbon Free, Cradle to Cradle, Global Recycling Standard, Gemeinschaft Umweltfreundlicher Teppichboden (Society for environmentally friendly carpets) (GUT) (carpets), Medically Tested (skin-tolerant textiles), Natur Textile, the Nordic Swan, and SKAL.

11 Conclusion

Sustainable textile production is now an important marketing tool to address the awareness of more demanding consumers. Ecolabeling systems are a good tool for this purpose. In this chapter, an overview of the major ecolabeling schemes specific to textiles was presented.

In general, it is normally expected that—independent of the country where textiles are produced—ecolabeled products should respect restrictions that go beyond the legislation in more developed countries.

The trend for "organic textiles" corresponds with this tendency. Specific labels have been developed to answer the demands of the market, imposing severe restrictions throughout the textile chain.

The large retailer chains are more and more forced on offering their customers "sustainable textiles." These companies often prefer to not use any of the existing ecolabels but instead are developing their own sustainability policies, imposing strict demands on their suppliers to assure that the textile products they sell are safe for the consumer, use environmentally friendly techniques, and consider social responsibility.

References

Almeida L, Tristram M (2012) Organic, ecological and fair trade textiles—New Demands, TRS 2012—Proceedings of the 41th Textile Research Symposium. Guimaraes, September. ISBN: 978 972 8063 67 2

Bassett T (2010) Slim pickings: fairtrade cotton in West Africa. Geoforum 41(1):44–55

Caniato F, Caridi M, Crippa L, Moretto A (2012) Environmental sustainability in fashion supply chains: an exploratory case based research. Int J Prod Econ 135:659–670

Hale M (1996) Ecolabelling and cleaner production: principles, problems, education and training in relation to the adoption of environmentally sound production processes. J Cleaner Prod 4 (2):85–95

Matrix Insight Ltd (2012) Study of the need and options for the harmonisation of the labeling of textile and clothing products. Final report for the European Commission DG Entreprise and Industry

Moore SB, Wentz M (2009) Eco-labeling for textiles and apparel. Sustainable Textiles, pp 214–230

Wakelyn PJ, Chaudhry MR (2009) Organic cotton: production practices and post-harvest considerations, Sustainable Textiles, pp 231–301

Zippel E (1999) Oeko-Tex labeling of textiles. Ecotextile 98:197–202